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Are You Selling or Waiting?

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An analysis of the equipment market leading to definite suggestions on how to sell under today's conditions

WHAT chance has the manufacturer of industrial equipment in times like these? When the public utilities have excess service capacity, and cities and towns are overbuilt, and manufacturing plants are only partly loaded, if at all; when industrial codes are filling their readers with doubts of the future; when threats of inflation freeze the long term investment market.

His chance would be slim indeed if it were not for two things:

1. The need of every business to adjust itself to meet the new conditions.

2. Old Man Obsolescence busy 24 hours a day, with his ally the inventor of improved methods and better equipment, to create an ever increasing market.

Confining our attention to manufacturing in order to simplify the question, let's see what the primary object of manufacturing is. Obviously, to produce goods, at a profit, for the individual consumer, or to produce goods that are to be used in producing such consumer goods.

What about this new partnership of government in business? What about quotas and cartels and prescribed wages, hours and profits? What about state socialism?

Suppose we cross that bridge when we come to it. We may be driven to all of those things some time, but not until the President and General Johnson are convinced that business leaders are unable to work out their own destinies under the National Industrial Recovery Act, with such help as NRA can give them.

Ignoring these bogies of the future, the degree of prosperity of a manufacturer is reflected by:

1. The volume of goods and products being produced.

2. The price at which these goods are sold.

Market Cycle Analyzed

To help to visualize the relationship of these indicators we have plotted in the accompanying diagram the index figures of industrial production and wholesale commodity prices from the "Survey of Current Business." Once you get the two plotted together definite trends are evident. The period under consideration divides readily into four markets:

1. A demand market, 1914-1920.

2. An obsolescence market, 1920-1922.

3. A creative demand market, 1922-1929.

4. An obsolescence market, 1929-?

These market cycle divisions can now be examined to see the effect on selling of our two favorable factors, needs of the manufacturer and obsolescence of equipment and methods.

1. Demand Market

During this period the distribution problem was a simple one. All the goods could be sold that could be produced and at a price that insured a profit. The problem then was one of production and it was during this period that manufacturers learned how to expand small plants into large producing units. The manufacturing costs, while important, were not a major problem due to the high level of prices. The selling problem was one of being able to deliver the goods.

2. Obsolescence (first period)

Then comes the fall in demand, which caused an even greater drop in prices, and in 1921 the manufacturer is confronted with two new conditions:

1. Producing goods to meet a much lower price level.

2. Selling goods in a highly competitive market.

It was not a difficult job, for the forward thinking manufacturer, to improve his manufacturing methods and thereby greatly reduce his costs. Some did this. Others depended on a greater sales effort to increase volume. The lower price level and increased sales effort produced volume results, as we see on going into the next period.

3. Creative Demand

During this period new records were made in sales volume, but how many

manufacturers made a profit? An examination of typical companies shows that the profit makers were those who put their plants in order so that with any reasonable volume they would show a good return. The unprofitable group were always reaching for more volume in the hope that a fully loaded plant would give them the answer to the need of profit. Their hopes were never quite realized.

The obsolescence period had been so short that these "waiters" were drawn out of the depression and into a volume market before they had time to exhaust their war period profits.

It is well to note that the price index fell during this period and in 1929 was one point lower than during the depression year of 1921. This was possible in a rising volume market, because there were manufacturers who were able to make good profits at these prices.

Better Methods Forgotten

The seller as well as the buyer lost sight of the need of better methods and the principal developments were based on a desire for more plant capacity, or to concentrate in larger and larger units.

4. Obsolescence (present period)

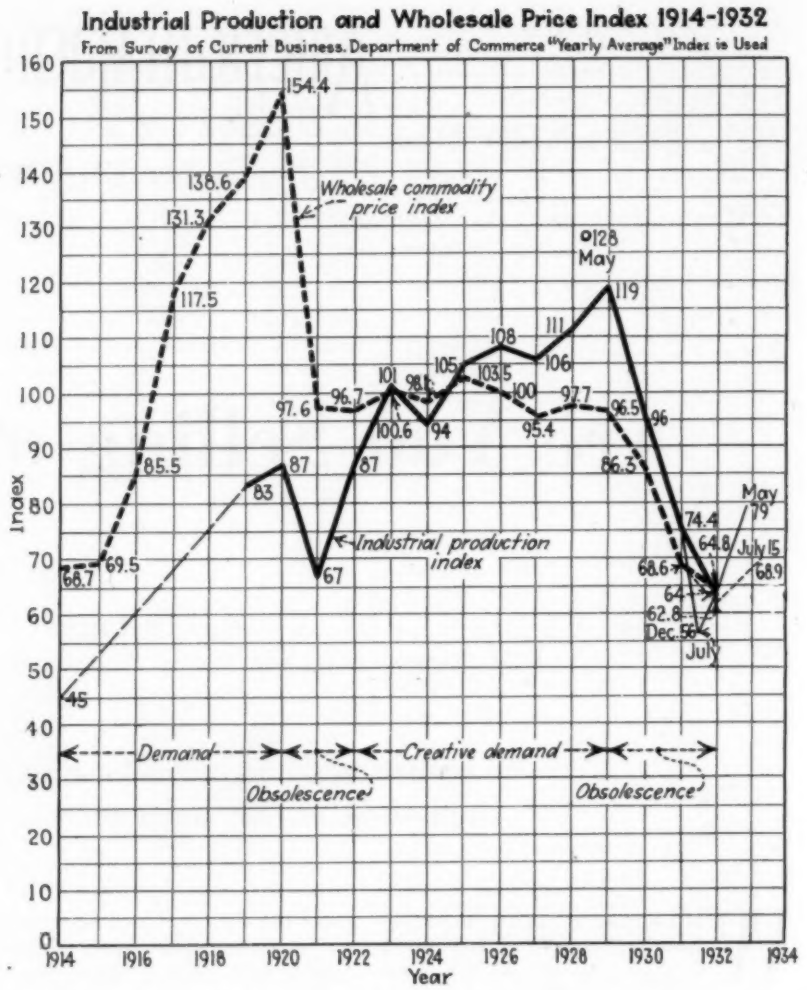
Today we are confronted with more severe problems than confronted us in 1921. The decline has been longer, there has been a greater drop in volume, and while the price level has dropped less during the period from 1920 to 1921 still its effect has been more severe due to a lack of profit spread.

Can the manufacturer become solvent or earn a profit under these volume and price conditions? The answer is found in the fact that some have been able to do this seeming impossible job by utilizing the latest manufacturing methods and equipment in their plants. They are doing what was done during the first obsolescence period.

When a manufacturer of hosiery spends $250,000 to rebuild his plant and by so doing reduces his costs over $1,000,000, he has met the problem.

When an automobile manufacturer spends $9,000,000 in plant modernization to turn out a better car at today's price level and make money on today's volume, then he has established a new price basis for his industry.

To meet these new conditions it is necessary for every manufacturer to put his house in order. He can not make changes without employing labor and buying new products and new equipment. To become a profit making institution he does, through necessity, create new business. The product selling group who will tune their selling effort to meet these needs of their prospective customers—learn to do creative selling in this



obsolescence market—can build a profitable business.

Such creative selling will not be blocked by the apparent excess producing capacity as this excess is not usable at present price levels.

The art of manufacturing is like any other art. It must go forward. It is only held back by a lack of constructive thinking. When we come into a difficult operating era, men are forced to think to survive, and in thinking evolve new ways of producing goods to meet the condition with which they are confronted. A review of the problems of manufacturing during this same period will show how developments were made to meet the conditions of the time and how the answer is being worked out in today's market.

During the demand era the constructive thinking of men like Taylor, Gantt and others, with their contributions of time study, cost accounting, piece work and process control, enabled manufacturers to expand their small, individually controlled plants into large producing units. In making this expansion the object was volume because a market existed and a price could be obtained which would allow the making of a handsome profit.

The first obsolescence era caused a return to a study of economy of manufacturing. This caused not only an improvement in existing methods by better cost accounting, time study, motion study, etc.; it also assisted in reducing costs.

The creative demand era witnessed a development and perfection of time study and motion analysis insofar as they related to a process of manufacturing. It was during this period that straight line assembly (such as developed in the Ford plant) was taken up by manufacturers outside the automotive field. But still the demand was so large that only the more progressive manufacturers modernized their plants in the light of accepted manufacturing practice.

During the period from 1914 to 1929, the major effort in manufacturing was to improve the process of manufacturing and to improve the efficiency of the individual worker in his relation to the process. As is the usual case there were a few pioneers who did not feel that manufacturing had reached its zenith and therefore continued to study ways and means of reducing costs. They found that in the struggle to improve the process of manufacturing most man-

ufacturers had lost sight of the necessity of controlling the motion of the product through manufacturing. The development of this idea showed that what were supposed to be modern methods of manufacturing could be improved so that costs could be reduced from 20 to 60 per cent under existing volume conditions. These savings were not all made by control of product but also by the addition of improved methods and machines in the revised plant layout.

The best estimates that can be obtained indicate that less than 20 per cent of the present operating volume is modern enough to produce at a cost that will allow the manufacturer to break even or make a profit today. Less than 10 per cent of the number of plants in numbers of units have been modernized for efficient and economic operation.

With ninety per cent of industry having the need of plant readjustment, then we have a clearly defined sales job. The prospective customer needs modern methods and equipment in order to survive. Sell that idea and then sell the product into the solution of the problem.

What Shall We Call These Threads?—*Discussion*

GILBERT G. COOMBS

In his discussion of this topic, John R. Godfrey made two statements (*AM*—Vol. 77, page 286) which, while not wishing to appear critical, I must question. Referring to the threaded steam-tight joint, Mr. Godfrey claims it to be "fortunately but seldom used." While it may be true that welded pipe joints have to some extent supplanted the tapered thread joint, the latter is still in everyday use throughout the civilized world. Further, the statement was made that "a really tight thread . . . must make complete contact to prevent flow around top, bottom or sides." Mechanical perfection of the threads, while desirable, is by no means essential to a tight joint.

Some years ago, one of the leading manufacturers of pipe fittings conducted an experiment to prove how little the tightness of a screwed joint is affected by accuracy of the threads. A piece of 8-in. pipe was threaded for a distance of 2¼ in. The pipe was then put in a lathe and the threads mutilated in the following manner. In the threaded part, three grooves were turned, each ⅛ in. wide and having a depth equal to the depth of the thread. The tops of the remaining threads, with the exception of the one at the end of the pipe, were turned off, forming a flat surface ⅛ in. wide. Next, at three places on the periphery of the tapered thread flat spots were filed, one inch wide and two inches long. Twenty-five longitudinal grooves were then filed in the threads, extending entirely across them, and in the threads of the coupling into which the pipe was to be screwed were filed twenty-five similar grooves.

When all this deliberate mutilating was finished, the threads were thoroughly cleaned and coated with a standard pipe thread cement. The joint was then screwed up so that the longitudinal grooves did not come opposite each other. The outer ends of pipe and coupling were plugged, and the joint was subjected to two tests: one of air pressure at 425 lb. per sq.in. and the other hydraulic pressure at 1,000 lb. per sq.in. In both cases, the joint was tight.

Other experiments conducted by the same company illustrate the importance of thoroughly cleaning the threads in both parts; also that great care should be exercised in assembling to avoid or overcome the friction incidental to screwing the parts together. The heat produced by this friction is particularly harmful in large joints when the male part is of lighter section than the female (as in pipe joints) since the male part will then expand more, then upon cooling, the contraction is of course greater, thus creating a tendency to leak.

(The experiments mentioned are of interest. But I cannot see how a joint with a few interlocking projections and a wad of cement to fill the mutilations, can be called a tight *threaded* joint. Metal will flow and form a fairly tight joint even without the cement, but I still do not consider it as ideal practice when it can be avoided. I was not thinking of pipe lines but of air or steam mechanisms. The main question, however, was what to call threads used for various purposes. J.R.G.)

Noise, Vibration and Cork *Discussion*

J. T. TOWLSON
London, England

While agreeing in the main with the remarks of John R. Godfrey on the above subject in his Seen and Heard column (*AM*—Vol. 77, page 264), my personal experience with cork as an insulating medium has been by no means encouraging.

With cork slabs 1½ in. thick and about 9 in. wide, I made a frame on which to set an Ingersoll air-compressor. The area of cork was quite adequate, but the area of the footing of the sole plate was very much less than that of the cork. The result was that the cork was quickly compressed, leaving the foundation bolts loose and necessitating tightening the nuts at short intervals. Although the cork effectively dampened the noise due to vibration, the continued loosening of the foundation bolts was a source of annoyance.

A concrete slab, 2 in. thick, was placed on top of the cork, and with fair success, although in a few weeks the concrete cracked in several places. Finally, the cracked slab was replaced with one well reinforced with expanded metal. The result was most satisfactory, the cork dampening the noise of vibration, the concrete spreading the load base, and the reinforcement preventing the concrete from cracking.

A Flexible Coupling Permitting Free Endwise Flotation—*Discussion*

JOHN E. HYLER

An interesting point is raised in the discussion between J. T. Towlson and Harry Shaw (*AM*—Vol. 76, page 565) with reference to endwise movement in a flexible coupling. In his criticisms of Mr. Towlson's article, Mr. Shaw goes so far as to say that the belt "will allow either member of the coupling to float endwise considerably more than will ever be necessary."

I have no quarrel with the mathematics advanced by Mr. Shaw or his statements insofar as they affect mechanism with only a moderate amount of "float." But where positive endwise oscillating shaft mechanisms are involved, where considerable end travel is necessary, special provision must be made to take care of it. The best solution is not, I believe, along the line of a sliding arrangement.

I know of one machine which offers an excellent example. It is a drum sanding machine, and the drum shafts are positively oscillated by a suitable mechanism. These shafts are directly-connected by flexible coupling to motors, mounted on brackets attached to the frame of the machine. The amount of oscillation is great enough that if the rotor were to be moved with the drum shaft, the lines of force in the motor would be so far distorted as to seriously affect its performance. It was necessary that the motor shaft be allowed to remain relatively free from oscillation. This was solved by using three leather links to fasten together the two parts of the flexible coupling. These links are fastened to the one half of the coupling by one end, and to the other half of the coupling by the other end, and their length is sufficient to take care of the oscillation. Friction, of course, is not a factor.

Heat-Treatment at River Rouge

J. B. NEALEY
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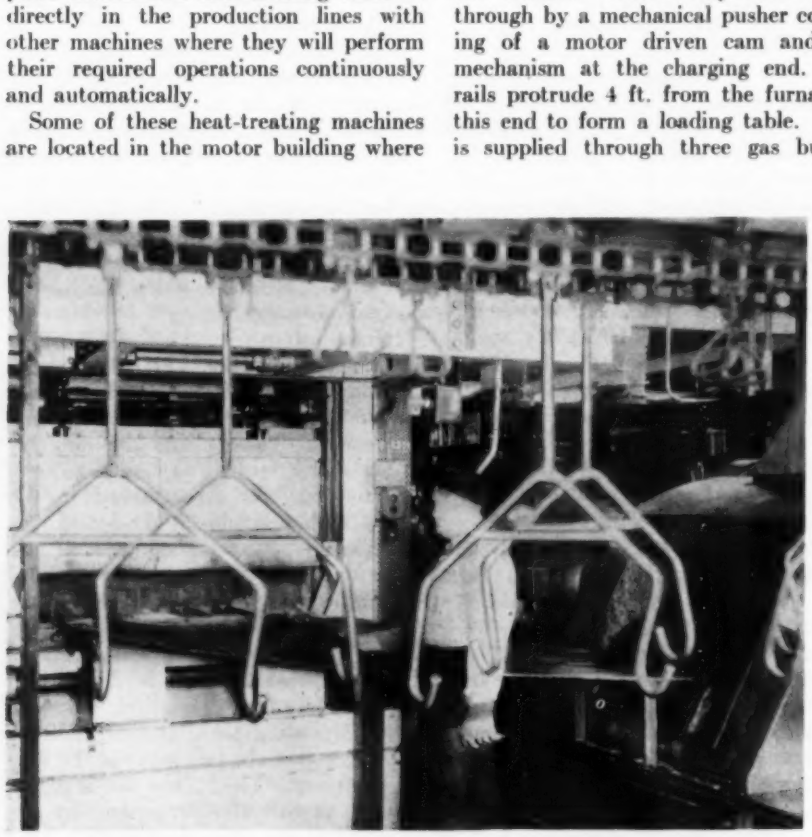
Close temperature control and careful placing of equipment characterize Ford furnace operation

HEAT-TREATING is handled in two different ways at the River Rouge plant of the Ford Motor Company. One way is to locate centralized heat-treating departments at strategic points throughout the several factories that make up this gigantic manufacturing unit. The other is to place mechanized heat-treating furnaces directly in the production lines with other machines where they will perform their required operations continuously and automatically.

Some of these heat-treating machines are located in the motor building where they are employed for various types of work. Hardening and drawing are accomplished in double units with quenches close by. These furnaces, 15-ft. long, 4-ft. high and 6-ft. wide, are constructed of brick and steel incased. The work is carried through on trays which ride on three steel rails placed on the hearth. These trays are forced through by a mechanical pusher consisting of a motor driven cam and link mechanism at the charging end. The rails protrude 4 ft. from the furnace at this end to form a loading table. Heat is supplied through three gas burners located in this end of the furnace and firing below the hearth.



A wide variety of steel parts is handled in pusher type furnaces in conjunction with quenching machines. Shoe-equipped tongs facilitate the transfer of hot work

A quench tank is located at the discharge end, and a steel chute runs from the furnace into the tank so the hot work does not come in contact with the air. The drawing furnace alongside is similar in size and construction; the work is removed from the quench and placed directly into the drawing furnace. The trays are returned to the front of the first furnace by placing them on edge in a track formed by two channel irons. These are sloped and provided with steel rollers in the bottom so that the trays simply roll forward. The desired temperature is automatically maintained with a recording potentiometer actuating a motor operated valve in the fuel supply line to the burners. The quenches are sunk to floor level and provided with motor driven apron conveyors to move the work through and out of the tanks.

Several other furnaces, similar to the ones described, are employed in normalizing such parts as pinion gears, universal joints, spiders clutch and brake pedals and worm gears. These are also of the pusher type and provided with automatic temperature controls. The recorders for all of these furnaces are located in a central control room where they are under constant surveillance.

Central Temperature Control

A heat-treating department in this building, devoted to skin hardening, includes 60 cyanide furnaces and five nitrate baths. The furnaces are circular, of brick construction and steel incased with hoods overhead for the removal of fumes. Quench tanks are spaced between and are provided with quenching fixtures of various types. Each furnace is heated with two gas burners firing tangentially to the inner radius of the furnace wall, the hot products of combustion swirling around the pots. These pots range in size from 17 to 30 in. in diameter. An overhead monorail with hoists is used to handle the pots. Each furnace is provided with a deviation meter at the furnace and a temperature recording pyrometer in the central control room.

In this central control room is located a recorder for practically every furnace in the building which are arranged on four long panels. Each morning the foreman of each heat-treating department makes out a report, showing the type of work, kind of heat-treatment and production schedule for his furnaces that day. These reports are turned in to the control room, and the temperature charts compared every few minutes during the day so if any temperature fluctuations are missed by the operators

at the furnaces they will be caught in the central control room.

Drive shafts, speedometer gears, universal joints, ring and pinion gears, drive shaft gears and spiders, are treated here. The temperature range is from 1425 to 1650 deg. F. and the quenching mediums are oil, water or caustic soda. Drawing is done in the nitrate baths at from 375 to 1000 deg. F.

Another heat-treating division in B building is equipped with 12 box type furnaces, 7 lead and cyanide pots and an oil bath. These are arranged in two long rows with a row of quench tanks between. The work is handled in baskets on an overhead monorail with hoists. The furnaces are all of brick construction incased in steel regardless of shape. The box type furnaces are about 5 ft. in all dimensions and are mounted on legs. They are underfired with gas burners. Three special cylindrical furnaces heat-treat long high-speed steel broaches. These furnaces are about 5 ft. high, 8 ft. in diameter and are heated with 10 gas burners each, 5 to a manifold. Each row of burners fires tangentially to the inner wall of the furnace and the work is put in through the top.

Air Cooling Reduces Warpage

These long broaches are preheated in one furnace to 1,500 degrees F. for about fifteen minutes and then superheated in another to 2,350 deg. F. which requires from one to five minutes longer. They are then quenched in oil or air, any over 20 in. in length being air cooled to avoid excessive warpage. Air cooling is done in a cage formed of four long perforated pipes, the hot broach being hung in the center and 100 lbs. of air forced against it through the perforations. The work is cooled almost as quickly in this manner as by dipping in oil, although it must be borne in mind that the oil quench is carried to only about 1000 deg. F. There is little difference in the hardness produced by the two processes. The work is then drawn to 1050 deg. F. for periods varying from two to four hours.

In addition to the broaches, milling cutters, gear cutters, and hobs practically all of the small cutting tools, jigs, and fixtures for the entire organization are treated here. These are made from high-speed steel produced according to Ford specifications, the analysis being:

Carbon	0.60 — 0.70
Manganese	0.25 — 0.35
Chromium	3.75 — 4.25
Vanadium	0.90 — 1.10
Tungsten	17.00 — 18.00
Silicon	0.20 — 0.30
Phosphorus	0.03 max.
Sulphur	0.04 max.

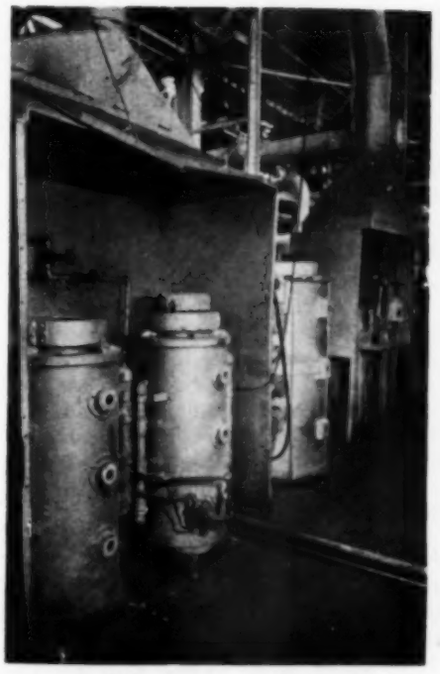
These furnaces are provided with an indicating pyrometer with multiple point switch board and two temperature recorders. In some of the other high-speed furnaces radiation pyrometers are used.

A non-shrinkable chrome alloy is employed in the manufacture of body dies in the tool and die division of B building, and its analysis is as follows:

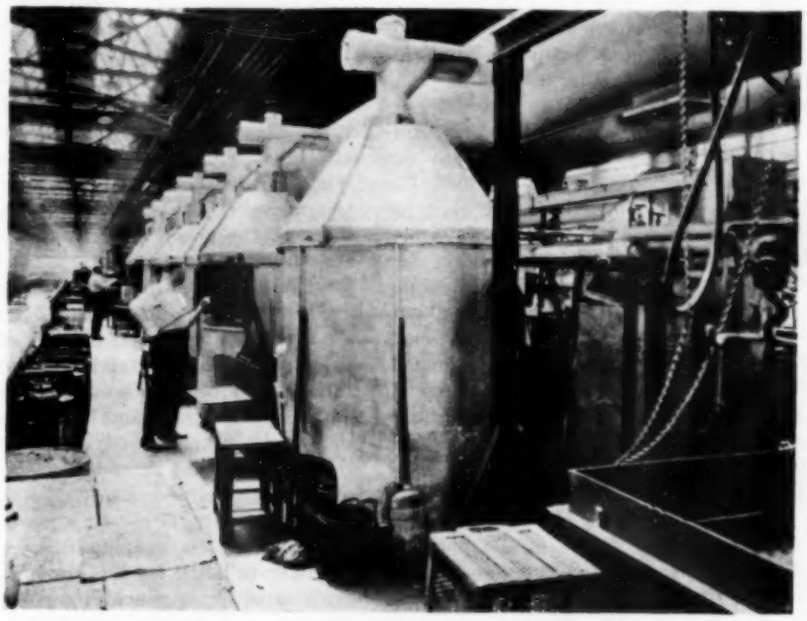
Carbon	1.54 — 1.60
Manganese	0.25 — 0.35
Chromium	11.00 — 12.00
Vanadium	0.20 — 0.25
Molybdenum	0.70 — 0.80
Silicon	0.20 — 0.40
Phosphorus	0.04 max.
Sulphur	0.03 max.

These are heat-treated in eight box type furnaces, each about 4 ft. in all dimensions and underfired with from one to three gas burners to a side. There is also a cyanide pot and a nitrate bath. These are in a single long row with a row of quenches opposite. After forging the dies are first annealed at 1650 deg. F. for three or four hours and then cooled. They are then preheated to 1250 deg. F. which requires from three quarters of an hour to four hours (one hour each for inch of cross section) and are then transferred to heat-treat furnaces and brought up to 1860-1880 deg. F. which takes from a half to 1¼ hours longer. After slowly cooling in air these dies are drawn in the nitrate bath or box type furnace at 980 deg. F.

Temperatures are observed in the high heat furnaces with ardometers connected to indicators. This instrument consists of a carborundum block set in the hot end of a refractory tube which pierces the furnace wall. The carborundum block becomes incandescent and the degree of this incandescence is reflected through a series of prisms on a sensitive tungsten disk inclosed in a case mounted at the other end of the tube. The varying degrees of heat are registered on an indicator.



Long high-speed steel broaches are preheated in one furnace and brought up to final heat in another. The work is charged and removed through the top



Parts quenched from these furnaces are removed from the tank by depressing the handle attached to a hinged basket. This dumps the work into a container placed on the shelf

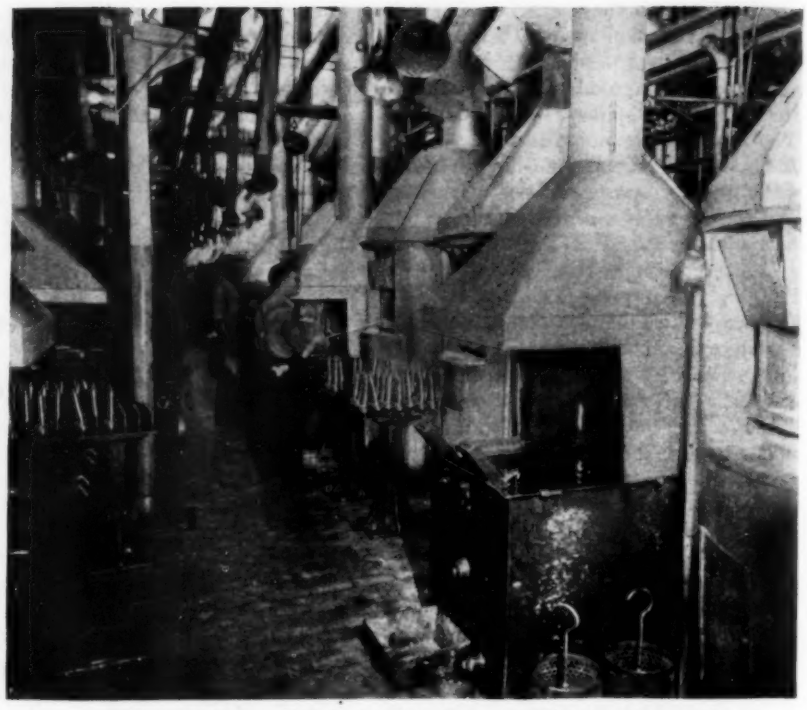
The tool hardening department in this building is provided with eight gas-fired furnaces including five box type, one lead pot, two nitrate baths and the proper quenches. These are employed interchangeably on different kinds of heat-treatment. Practically the same layout may be seen in the tool room of the pressed steel building. Elsewhere in this latter building is an unique furnace for annealing the tops of radiators prior to forming the cap spout hole. It is a brick furnace 5 ft. long, 2½ ft. wide and 4 ft. high and on one long side are four depressions, each of which is shaped to take the top of a radiator. There is a hole in the bottom of each depression through which the heat is forced from the combustion chamber, which in turn is heated by four gas burners.

Cam shafts are normalized in a continuous furnace 25 ft. long, 6 ft. wide and 7 ft. high, that is heated with four gas burners on each side. The hearth is built with four parallel slots running the full length of it. These slots are triangular shaped in cross-section with the small end up. In the bottom of each is a water pipe for cooling and on this rests an alloy rail while on each rail rides a loop chain conveyor. These chains carry spindles, closely spaced, which protrude up through the slots in the hearth and support the cam shafts while they are passing through the furnace. The chains are motor driven through speed reduction gear trains.

Selective Hardening

The standard method by which automobile hubs are made today is to hot forge the hub proper out of steel and then force a hardened steel sleeve into the center hole for a bearing surface. An improved method is in use in this plant by which the sleeve is eliminated. This is effected by hardening the steel forming the face of the center hole to the right degree for a bearing surface, the hub then becoming the outer race for the wheel bearing. This is accomplished as follows: The bottom ends of the hubs are heated in cyanide, a rotating fixture just over the bath being employed. When up to 1600 deg. F. each is removed and placed in an oil quench where the oil is sprayed on the lower ⅜ in. for about five seconds. The hub is then transferred to another quench where water is sprayed over the entire inner surface.

The reason for the ⅜-in. quench is to obtain a proper degree of toughness so that this section will remain intact should the rest of the hub be smashed in an accident. The selective quenching momentarily hardens this rim but the heat from the rest of the hub, flowing back into it, draws and toughens it.



Small work is handled in baskets for cyaniding, and special precautions are taken for fume elimination

Occasionally, it is necessary to carburize heavy cams for large automatic machines and these range from 3 to 5 ft. in length, 2 to 3½ ft. in diameter and are about 3 in. thick. They are made from steel of the following analysis:

Carbon	0.20 — 0.24
Manganese	0.60 — 0.75
Chromium	0.65 — 0.80
Vanadium	0.12 — 0.15
Silicon	0.10 — 0.15
Phosphorus	0.03 max.
Sulphur	0.04 max.

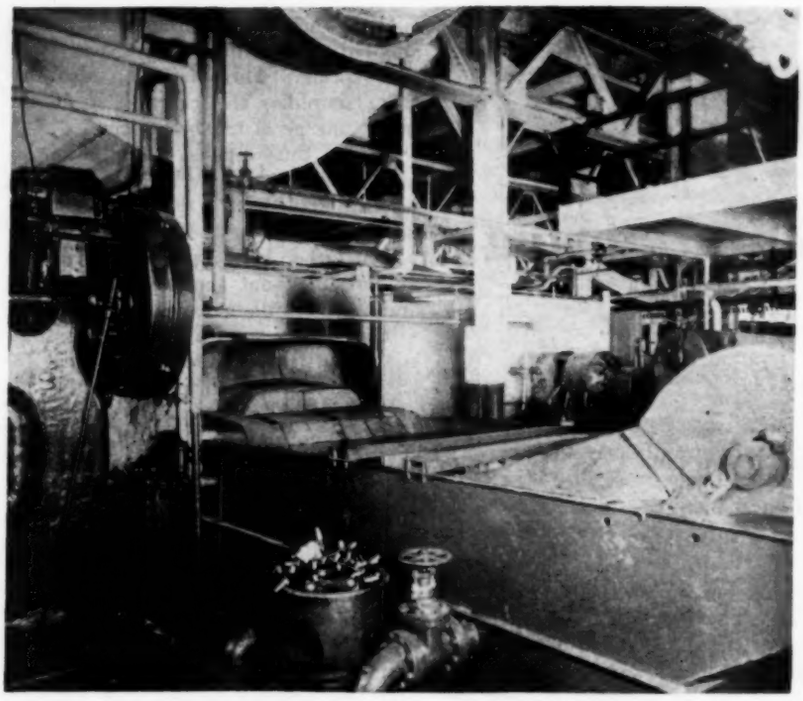
These cams are packed in large circular steel boxes with carburizing compound charged into a furnace and heated to 1700 deg. F. The larger cams require up to 60 hours of heating. The case runs in depth from ⅛ to ⅞ in. Car type furnaces in one of the forging divisions of the spring and upset building are employed together with heavy cranes for handling the work.

These furnaces are about 16 ft. long, are fired with three gas burners on each side, or six in all, and the cars are run in and out on special tracks. A motor-operated rack and pinion, between the tracks, is employed in moving the cars and the front opening is closed with a counter weighted door.

The steel mill building contains a group of eleven cyanide furnaces and two nitrate baths for the hardening and drawing of spring shackles and bolts. In the tool and die division of this building is a heat-treating department containing between 20 and 30 furnaces, mostly box type, and nitrate baths, while still another section is provided with eighteen furnaces. There are many other heat-treating furnaces, both of the batch type and continuous type, scattered throughout River Rouge, but those described provide a good picture of how most of the parts are treated and indicate the close control maintained.

Hardening in the motor building is accomplished in 70 gas-fired cyanide furnaces which are located in four rows, two outside rows and a double inside row. Down the center of each of the two aisles between operates an overhead monorail system. Oil or water quenches are located between each two furnaces. There is a central control room with a deviation meter for each furnace while at the furnace itself is a three-light system which shows whether the temperature is correct, too hot or cold. Idler gear shafts, transmission gears, shifter shafts, steering worms, steering column sectors, and steering gear ball studs are hardened here at about 1500 deg. F. and are drawn in nitrate baths. Each nitrate bath has its own automatic temperature controller. While many parts are hardened in cyanide merely as a matter of convenience, others are heated in the same medium for case hardening.

The tool and jig division of the foundry has a heat-treating department equipped with two rows of furnaces. In one row are ten box-type furnaces while the other contains two box furnaces, four cyanide furnaces, two nitrate baths and one lead bath. A row of oil and water quenches occupies the center aisle.



Conveyors carry oil pans through the normalizing furnace and quench to give a continuous work flow

The box furnaces are of all sizes and are fired with varying numbers of gas burners. The nitrate bath is heated with four gas burners while the oil annealing bath, 10 ft. long, 3 ft. wide and 4 ft. deep, is heated with two gas burners. There is also one big continuous and automatic annealing furnace in this division, similar to those already described, except that it is fired with six gas burners.

One heat-treating division of the spring and upset building is located in a balcony. Here eighteen cyanide furnaces are arranged in two rows back to back with quench tanks spaced between them. Each is heated with two gas burners and is provided with a deviation meter and a tell-tale light system consisting of green, white and red lights which come on when the temperature is too low, correct or too hot, respectively. There are also ten temperature recorders. Front spring spindles and shackle bolts are hardened here. The burners on most of these furnaces are equipped with inspirators which receive gas at 15 lb. pressure and entrain air in any ratio desired. Thus any furnace atmosphere, reducing, neutral or oxidizing, can be had, and once set, the burner will be automatically maintained regardless of the volume of work.

Elsewhere in this building are more cyanide furnaces and nitrate baths together with a lead pot and furnace 10 ft. long, 6 ft. wide and 4 ft. high, all fired with gas. The bottom portion of hubs are hardened in this, and these are held in a fixture consisting of a steel plate with slots in it, which sets just far enough above the bath for the section to be treated to be submerged. This furnace has an automatic temperature control, an indicating pyrometer and a recorder and in addition it is equipped with a horn which automatically sounds in case the temperature rises above a certain point.

Oil pans are annealed in a continuous furnace which is 8 ft. wide, 7 ft. high and 20 ft. long and is fired with three gas burners on each side. This is provided with three parallel chain loops suspended between sprockets at each end of the furnace. These chains have dogs bolted to them, and these dogs protrude through slots in the hearth so that the pans ride through the furnace on the dogs. Of course the chains are driven through a motor and speed reduction gear train. The pans are dumped automatically at the discharge end into a soap water quench provided with an apron type conveyor which carries them through and out of the quench. There are two of these furnaces.

Weeding Out Obsolete Tools

JOHN R. GODFREY

George Peters was in Old Man Johnson's office the other day. "What's on your mind, George?" asked the O.M.

"Tool cribs at the moment, Johnson. They sure take up a lot of space. I wonder if all shops have the same trouble. Business isn't booming yet, even if it is better, and yet the tool department is howling for more space."

"Just what do you keep in the tool cribs, George?"

"All sorts of tools used in the department. Drills, reamers, taps and fixtures of all kinds. We build so many kinds of motors it means a lot of tools. Every day some bright designer gets a new idea. Then we have to make new tools and the tool crib bulges out at the sides."

"And what becomes of the old tools?"

"Why, we keep them, of course. We can't throw them away because we've put out a lot of motors that used these tools. We have to keep them for spare parts that may be needed. That's what clutters up the tool cribs."

"But, you don't have to keep them all in the tool crib, George. Why not have a sort of substorage for tools that are only used on repairs or special occations? Why clutter up the tool crib with out-of-date tools? Unless, George, and I rather guess this is the real reason, you don't really know which tools are used and which stay in the crib week after week."

"There is more truth than poetry in that, Johnson. I've asked the tool crib men if they would sort out the tools we could discard, and they aren't just sure about it. So, rather than throw out the wrong tools, they keep 'em all. How would you do it?"

"One of my friends is up against the same sort of thing, George. He is in a shop where designs change rapidly and new tools spring up like mushrooms. His tool crib men were as uncertain as yours. Then he fudged up a plan of his own."

"That's just what I want to hear about. If he can sort them out, he's good."

"Seems simple enough, George. He has a card for each tool. He uses one of these metal holders that hangs the card in a frame or slide. When any tool is checked out the crib man stamps the date on the card. If the tool isn't checked out for a month he puts a red mark on the card. A glance at the card holder shows every red mark. Each month a tool isn't checked out he puts on another red mark.

"Any tool that shows six red marks on its card comes out of the crib and goes into a substorage where room isn't so valuable. The card goes with it. Once a year the production men go over these cards and decide which tools can be scrapped."

"Sounds O.K., Johnson, but it costs money."

"So does keeping them in the tool crib, George."

How to Select a Helical Spring

GEORGE P. PEARCE

Spring calculation is simplified for shop usage by means of two charts

In almost every industrial plant there are times when the engineer is called upon to pick out a spring for some purpose or other, and generally he is expected to give the specifications right off the bat. The standard formula for springs, however, involves squares, cubes and fourth powers. Raising fractions, such as $\frac{3}{4}$ for example, to the fourth power is a somewhat tedious job. In about 99 per cent of the usual problems, this can be avoided by the use of charts, but unfortunately, most charts in themselves are rather complicated. They attempt to cover almost every possible spring combination imaginable, and furthermore, many of them cannot be used at all without a straight edge, sharp pencil and a flat surface. These auxiliaries are not always handy. Simpler charts can be designed if they are confined to more standardized conditions and if the basis upon which they are prepared is thoroughly understood.

In general shop practice, nothing but round wire springs are used and therefore the charts for the engineer can be confined to wire of this section. Then again, it is conceded by authorities, that the best springs are those which have a pitch diameter equal to eight times the diameter of the wire of which they are made. This ratio, therefore, should be adopted at once and used for every possible spring. This limitation also furthere simplifies the charts and at the same time gives the best spring.

Having thus decided upon the spring pitch diameter for every gage of wire, we can immediately determine the capacity load for every size of wire, or inversely, when we know the load we can at once pick out the best size of wire and the pitch diameter of the spring.

The springs used most around industrial plants rarely exceed ¼-in. gage for the wire so if the spring charts include all sizes up to, say, ⅜-in. wire diameter, they will cover practically all needs. On this basis Charts I and II have been designed. Chart I shows the relation between capacity load and all gage sizes of wire up to ⅜ in. inclusive and also the pitch diameter that any size spring wire up to ⅜ in. diameter should be coiled to in order to carry the load shown. Note that adding one wire diameter to this gives the outside diameter and subtracting one wire diameter obtains the inside diameter of the spring. Thus, as soon as the capacity load is known, the best wire size and also the outside, the pitch and the inside diameter of the most satisfactory spring may be quickly selected.

We have not yet, however, learned the proper length of spring as this, of course, will depend entirely upon the condition under which it has to work. Since these conditions vary considerably,

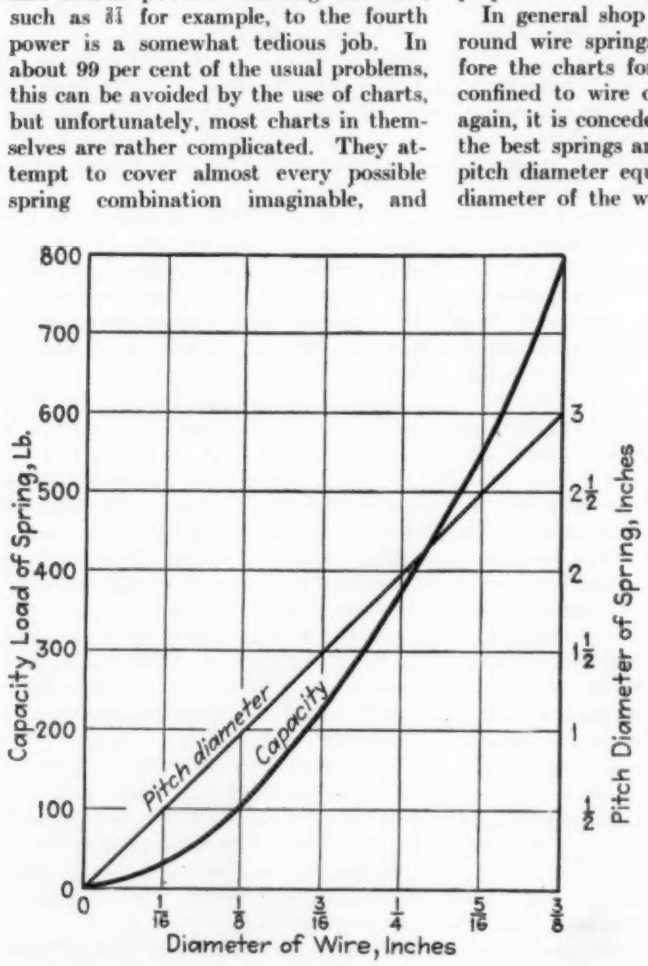


Chart I—Relation between diameter of wire, capacity load, and pitch diameter of spring. Ratio of wire diameter to coil pitch diameter equals 1:8

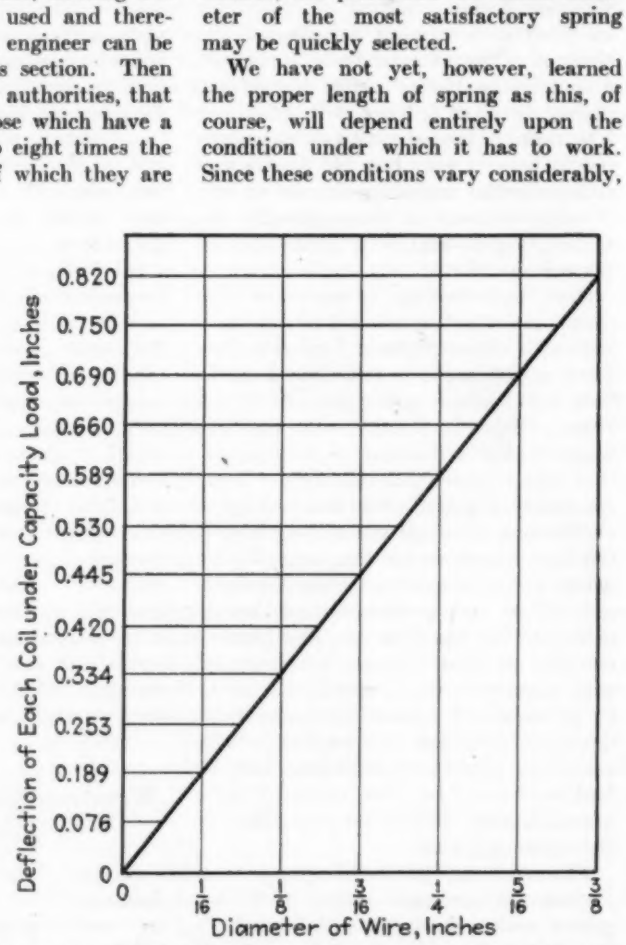


Chart II—Relation between diameter of wire and deflection of each coil. Note that the deflection spacing is slightly distorted to make a straight line chart

it would make an awkward chart to give the proper length directly. There is no need to attempt this when we can make it quite simple by confining it to the movement of each coil of wire. Then we can quickly determine the number of coils and their spacing by a simple calculation. Chart II gives the total deflection of any coil up to 3/8-in. wire when loaded to its rated capacity.

Examples Show How

The method of using these charts may perhaps be shown best by examples, so let us take three problems such as might easily arise around the plant and find the proper spring specification for each.

Problem 1: A large diameter light-wall all-welded pipe is to be hung from roof trusses that have considerable vibration, and therefore, the suspension must be cushioned. This is to be accomplished by means of a compression spring in each of twenty hanging rods. The weight to be supported by each of these springs will be 180 lb. Give the specification for suitable springs that will compress about 1 7/8 in. when carrying this load.

Answer: Chart I immediately shows that 7/64-in. spring wire is good for 213 lb. capacity. That is, if the spring is properly spaced and is of right diameter, it will take 213 lb. to close it. This is 33 lb. more than specified which will allow for shop jars and vibration. Having thus decided upon 7/64-in. wire for the spring, we find that the pitch diameter will have to be 1 1/2-in. From this the outside and inside diameter are quickly determined. The length of the suspension rods has been designed so the spring must compress 1 7/8-in. under the 180-lb. load. By looking at Chart II, we find that the capacity load 213 lb. will close each coil 0.445 in., and by applying the rule for simple proportion: $213:180::445:x$, we find that each coil will close a distance of 0.376 in. when under a load of 180 lb. We can call this distance 3/8-in. and since 1 7/8-in. is five times 3/8-in., it will take five working coils to obtain the required compression. Since the top and bottom coils are usually ground and set, it is customary to add two coils to the number of working coils to get total coils which, in this case, will be seven. The free length of the spring will thus be $7 \times 7/64 = 1\ 7/64$ in. plus five spaces of 0.445 in. which equals $1\ 7/64 + 2.225$ or 3.537 in. We can call this 3 1/2 in. and use a standard spring length. Now we can write the specification as follows:

20-helical compression springs. 7/64-in. diameter wire; 1 1/2-in. pitch diameter; 7 coils; 3 1/2 in. free length; 1 7/64 in. short length.

Problem 2: An elevator boot is to be fitted with spring release bearings so that, when the belt is tensioned up to 600 lb., the compression spring will still have 1/2 in. to go in case something gets jammed between belt and pulley. Also by measuring the compression on each spring, it is to be determined when the belt has the correct tension. Specify spring; give free length; length when belt has proper tension, and shut length.

Answer: Since there are two bearings, each spring will only have to carry a load of 300 lb. when belt is properly tensioned. Chart I shows us that the nearest spring is one made from 1/4-in. diameter wire. This, we see will carry a capacity load of 385 lb. The same chart next shows that the pitch diameter of this spring will be 2 in. and Chart II gives the deflection at capacity as 0.598 in. per coil. From this, we figure from $385:300::0.598:x$ that $x = 0.465$ in. compression per coil for proper belt tension. This leaves $0.598 - 0.465 = 0.133$ in. per coil to go. To allow the 1/2 in. extra travel we will need $0.5 \div 0.133 =$ say 4 coils or a total of $4 + 2 = 6$ coils. The shut length of the spring will thus be: $6 \times 1/4 = 1\ 1/2$ in. The free length will be $1\ 1/2 + 4x$ which equals $1\ 1/2 + 2\ 3/8$ or 3 7/8 in. The length of the spring when loaded to 300 lb. will be $3\ 7/8 - 1/2 = 3\ 3/8$ in. We can now write the spring specification:

Two helical compression springs 1/4-in. diameter wire; 2-in. pitch diameter; 6 coils; 3 7/8 in. free length; 1 1/2 in. shut length.

Controlling a Valve

Problem 3: A swinging valve at the bottom of a vat is to be held tight by means of an extension spring. As soon as the load passes 500 lb. the valve is to open. Valve travel restricted to 1 in.

Answer: Chart I shows that spring made of 7/64-in. wire has a capacity of 550 lb. At 500 lb. this spring would be stretched 500/550 or 10/11 of its safe travel. The same chart gives the pitch diameter of the spring as 2 1/2-in., and Chart II shows that each coil will deflect 0.69 in. when carrying capacity load. When the valve opens, the spring will have to be able to extend another inch and not load up more than 50 lb. in doing so. Therefore the spring has to extend 1 in. for every 50 lb., and when the spring is loaded to capacity, it follows that it has to be extended a total of 11 in. from its closed, or free, condition. We have found that each coil opens 0.69 in. at capacity load, and so the spring will have to have $11 \div 0.69$ or 16 coils. Since the end coils in tension springs are not flattened and set we will only have to add one turn to make 16 spaces. This will make the closed, or free, length of the spring $17 \times 7/64 =$ 5 7/64 in. When installed, the spring will have to be drawn out until it has extended 10 in., and by then, it will be exerting a pull of 500 lb. on the valve.

Now we can specify the spring:

One helical extension spring 7/64 in. diameter of wire; 2 1/2-in. pitch diameter; 17 coils; 5 7/64-in. closed or free length.

Other problems can be handled in the same manner.

A Rapid Gaging Device
Discussion

JAMES MCINTOSH

Referring to the article by Peter L. Budwitz under the title given above (*AM*—Vol. 77, page 189), the device described, as applied to lathe toolholders, has no value over the ordinary micrometer collar on the crossfeed screw, and is less effective in controlling sizes.

For grinding repetitive work, one make of grinder is fitted to make the control of close limits in diameter a simple matter. The diameter of a piece being ground is carefully measured to get a base from which to start. Assume that the piece is a certain amount oversize. A thumb latch is pressed against its stop four times for each 0.001 in. that the piece is oversize and the machine automatically reduces the diameter by that amount, due to the stop control. The operator can use this stop control to produce precision results.

The tendency in either grinding or cutting is for the wheel or the tool to wear and increase the diameter of successive pieces. Assuming that after six pieces have been ground, the sixth piece is 0.0005 in. oversize. That means that the thumb latch must be pressed once for every three pieces ground to compensate for the wheel wear and to keep the work within the required limits.

In grinding work where close limits are to be maintained, wet grinding is imperative for two reasons. First, to prevent the wheel from clogging and second, for the generated heat to be assimilated. The accurate measurement of a piece in process means that the piece must be dry and free from grit. To stop both the machine and the flow of coolant and to wipe the work and the hands is essential to protect the micrometer from moisture. On the other hand, where the thumb latch control is a part of the equipment, a properly trained operator stops the machine, removes the piece, loads another and starts the machine. While the second piece is being ground, he has time to check the diameter of the first piece. If there is any tendency for the machine to grind oversize, he can adjust the stop by the latch.

Gear Lapping as a Production Job

SAM TRIMBATH
Gear Consultant

To those in quest of quiet gearing, the author recommends lapping and clears up some of the vagaries that have surrounded this subject. Among other things, he discusses the effect of long and short addendum on this operation

GEAR lapping when something more than merely a polishing or salvaging operation presents many possibilities in the way of quieting gear operation. Everyone who has been responsible for the production of quiet gearing over an extended period of time is almost certain to have resorted to lapping in some form as the requirements became more severe. Often the aim of all preceding operations is to eliminate the necessity for lapping at all which, in a sense, is a worthy objective. However, this may impose a handicap on the lapping operation and prevent a full realization of its possibilities. It is my belief that the full value of this process will not be realized until it is looked upon as the final operation in finishing gear teeth, with design and all preceding operations influenced by the consideration, "Will the gear lend itself to lapping?"

The problem of gear lapping has been approached from many angles and has received a great amount of attention in the field of automobile gearing. In fact, the trends of motor car design have influenced gear requirements, and in many cases, have focused attention upon the subject.

The closed car superseded the open, steel bodies came into use, bodies were lowered, and steel stampings and weldings replaced castings at various points throughout the car. The result was that many gear practices that had proven satisfactory for certain models had to be revised to suit the new. Even today, it is not uncommon to have gears prove entirely satisfactory in one make of automobile and have the identical set prove objectionably noisy in another. In other words, one construction will tend to dissipate and the other to amplify the gear noise.

Rubber insulation is often used to lessen the severity of gear requirements. However, its use is not always possible, and the gear manufacturer has to meet existing conditions without any assistance of this sort. Regardless of other considerations, aside from actual mechanical or metallurgical failure, the quality of his product is judged largely by quietness of operation. In fact mechanical tolerances mean little if this quality is not attained. It has been my experience that mechanical measurements serve only to control the products up to a certain point and that the final finishing touches should be given by a lapping operation.

Were it possible to collect and analyze the results of all experimentation relative to lapping, much interesting and valuable information could, no doubt, be obtained. This is hardly possible when we consider the many variables surrounding the operation, the probability that many practices are built upon experience gained with some one type of gear and the lack of records of many experiments. For these reasons, this article takes the form of a summariza-

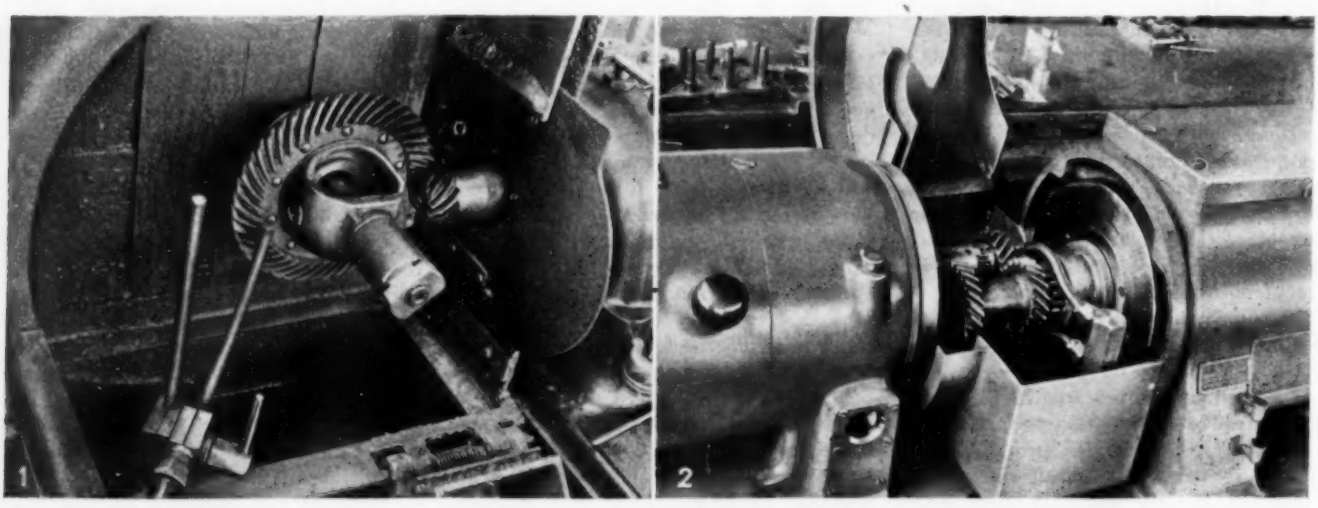


Fig. 1—Spiral bevels were the first automobile gears to be lapped in production. Fig. 2—Steep angles make lapping more effective for both helical and spiral bevel gears

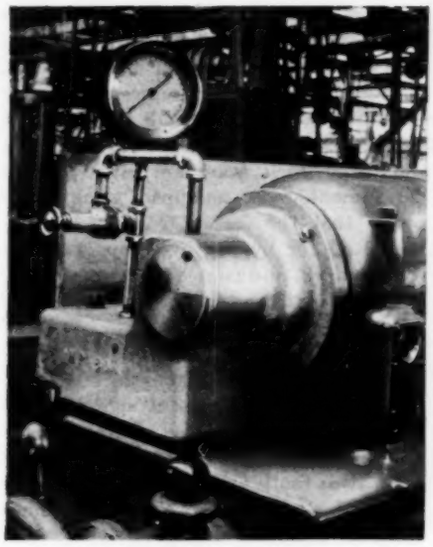


Fig. 3—Uniform braking on the driven spindle may be obtained hydraulically

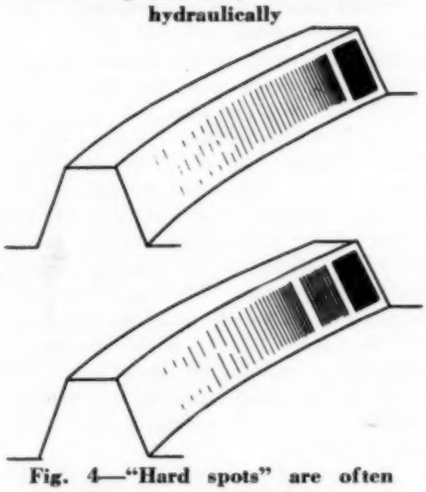


Fig. 4—"Hard spots" are often traceable to poor distribution of the lapping compound

tion of observations made during the course of my work in connection with gearing for motor cars, and I trust the conclusions will aid and assist those who are interested. Lapping is one phase of gearing on which I can find but little data in print.

Until recent years automobile transmissions were of the spur gear type, and as the gears were under load only a small portion of the driving time, some noise was generally accepted.

For rear axle gears the necessity for quietness under load was imperative, as all car driving is done through this unit. The result was an early adoption of spiral bevel gears instead of straight bevels and, in time, an almost general recourse to lapping. In both spiral bevel and plain helical gears, mating gears are of opposite hand, and for purposes of discussing general characteristics of lapping, the two types can be considered to be identical.

The term "lapping," as referred to in this article, is the operation of running the gears together in pairs (Fig. 1 and 2) with an abrasive introduced between the teeth. This is more of a running-in than a strictly mechanical operation where the teeth would be formed to a predetermined shape. The running-in procedure would seem to preclude any possibility for interchangeability, a matter that may cause some alarm, but both helical gears and spiral bevel gears lapped by this method have been found to interchange as well, if not better, than when an attempt was to produce them by strictly mechanical means. This is probably because of the small and what at times seems to be an almost infinitesimal change in tooth properties. However, my experience is that gears will operate more quietly when kept in the original pairs.

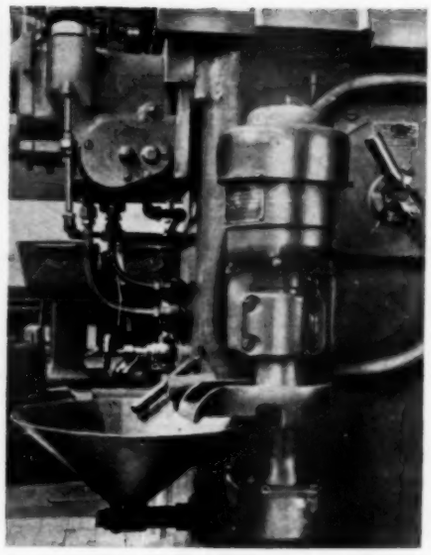


Fig. 5—Settling of the abrasive is eliminated by the use of a funnel-shaped tank

My attention was first called to lapping as a possible means for salvaging gears that were objectionably noisy. The results obtained were erratic, it being looked upon alternately as a curse and a blessing. This was mainly caused by make-shift methods employed at the time and failure immediately to recognize requisites which later experience proved quite necessary.

The first requisite for successful lapping by the running-in method is smooth driven, free running work spindles. Countershafts, unbalanced pulleys, unbalanced belts or anything tending to increase vibration and cause uneven loads should be avoided.

Another reason for erratic results was the attempt to decrease lapping time by increasing the brake load applied to the driven spindle and failure to maintain a uniform brake pressure. Friction brakes having non-metallic linings, which are likely to gum up or expand from the heat generated and cause a change in tension, should also be avoided.

The brake tension applied to the driven spindle should at all times be enough to insure keeping the mating profiles in contact. A hydraulic brake and recording gage (Fig. 3) for regulating the tension is recommended. To obtain the best results, the pressure built up at the brake requires a consideration of several factors, such as the abrasive used, gear diameters and r.p.m. of the work spindles.

The time consumed in lapping depends largely on the above factors. The r.p.m. of the spindle is limited by smoothness of the drive and rigidity of the mountings. For well designed, well mounted spindles such as used on Gleason spiral bevel gear lapping machines, 1500 to 2000 r.p.m. is not excessive.

The abrasive used in lapping is in the form of a powder and is usually mixed with oil before applying. The question of a suitable compound has proved a fertile field for experimentation, and the material employed can always be viewed with suspicion when results are erratic.

Even Compound Important

In the early stages of lapping, machine operators applied the compound with a brush, and results depended largely upon their skill in its application. Today lapping machines are usually equipped with pumps for the purpose, and while this has reduced the necessity for skill on the part of the operator, there is still a possibility that the compound will not distribute uniformly over the tooth surfaces. This is especially true if the mixture is at all thick and the rotative speeds high. Poor distribution often causes spotted bearings that are discernible to the naked eye. These markings are usually referred to as hard spots and have an appearance similar to Fig. 4. When this occurs on the small ends of the teeth of spiral bevel gears, they are noisy under light loads.

When pumps were first used for applying the compound, heavy oils were used, the thought being to keep the abrasive in suspension and prevent settling at the bottom of the compound tank. It was found that such oils were readily affected by temperature and that any change in fluidity was likely to bring about variable results.

The use of light oils, while enhancing the uniformity of compound spread, brought about a problem of agitation. This was solved by designing a small funnel shaped tank (Fig. 5). The small end of the tank leads directly into the pump, and the capacity of the tank, (about two quarts) insures rapid circulation of the compound. Light lubricating oils are used in the mixture and

kerosene could be used if necessary. To prevent the abrasive from settling when the pumps are not in operation, the tanks should be drained if they are stopped for an appreciable length of time.

The question of abrasive grain size is one that is open to preference. As a general statement it may be said that better control is attained through the use of the finer abrasives, but if they are too fine, there will be a penalty in an increase of lapping time. For the average run of helical and spiral bevel gears, I have found a mixture of two parts 320-grain abrasive to three parts of light lubricating oil by weight a satisfactory combination.

Since gears have been successfully lapped by the running in method, the question is frequently asked, "Would not the gears have eventually become quiet through actual service?" A consideration of the preceding paragraphs will go far in answering this question. For example, automobile gears are subject to varying loads and consequently varying degrees of tooth deflection. What may be considered light loads are likely to be many times the load applied in lapping, and at best, the gear drives and mounting are not comparable to what is used in successful lapping.

When satisfactory equipment is available, attention can be given to the type and design of gear that will lend itself most readily to lapping. Attempts to lap spur and straight bevel gears, have, in the main, proved disappointing. The greater the angle in both helical and spiral bevel gears the less difficulty has been experienced in attaining the necessary degree of quietness. Angles as low as 15 deg. were at first used, and they have been gradually increased as the requirements became more severe up to and, in some cases, beyond 45 deg.

Precision Gears May Be Noisy

The noise produced by gearing at times seems out of all proportion to the mechanical errors involved, and it may be assumed by those not familiar with the subject that noisy gearing represents inaccurate workmanship. As a matter of fact, it is not uncommon to have manufacturers of gear equipment claim the ability to work to tolerances of 0.0002 in. in both tooth profile and spacing. The former means the tolerance in base pitch (Fig. 6) between mating gears, and the latter the difference in base pitch between any two successive teeth. It is unfortunate that attempts to maintain these tolerances did not show greater promise of attaining the desired result, as the construction of spur type automobile transmissions is not complicated. Nevertheless, spur

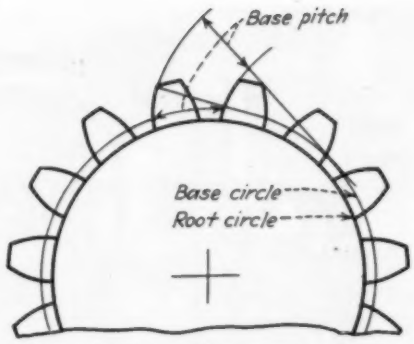


Fig. 6—Close tolerances in tooth profile and spacing may not in themselves make quiet gears

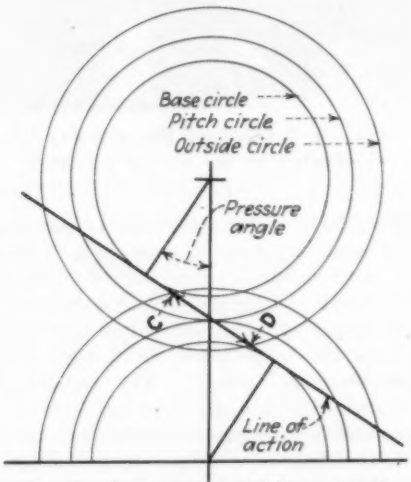


Fig. 7—Spur gears will be noisy if the line of contact is less than the base pitch

gears made and measured by little less than laboratory methods, were disappointing, when judged by the quietness of operation.

The introduction of the helix angle plus lapping has, in a large measure, avoided the necessity for extreme accuracy in the matter of tooth profile and has also minimized the importance which must be placed upon the selection of tooth depths and outside diameters when spur gears are considered.

In spur gears the teeth must be proportioned so that the length of contact *C D*, Fig. 7, is equal to or greater than the base pitch. Reducing *C D* beyond this point, either by reduction in the gear outside diameters or modification of the involute profiles, will cause the gears to be noisy at practically all loads and speeds.

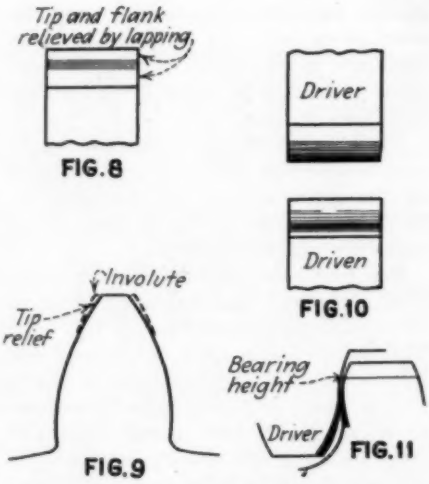
An examination of some quiet helical gearing after lapping shows quite a departure from the true involute profile. Some gears, that came to my attention, had what is termed a "shoe-string bearing", the bearing being concentrated over a narrow portion of the tooth profile as in Fig. 8. A similar condition in spur gearing would, through loss of contact, be little less than disastrous.

The above should not be taken to mean that extremely narrow bearings are the aim in lapping helical gears. Quite frequently they represent over or uncontrolled lapping and are quiet at one center distance only. However, the fact that such gears are often an improvement over unlapped gears, indicates that the loss of contact is compensated for by the overlapping action of the helix, and consequently, the selection of tooth parts is not as critical as in spur gearing.

For the foregoing reason, plus considerations of tooth strength, less stock to be removed when cutting, and less tooth area to be lapped, I favor tooth depths, comparable to that of the Fellows stub tooth system, over full length teeth of standard depth, for both helical and spiral bevel gears.

Modifications of the involute profile similar to that produced by lapping are at times practiced in gear cutting. This is what is often referred to as "tip relief," the tooth profile departing from the true involute near the tops of the teeth, Fig. 9. The idea is to bring the teeth into engagement without shock and to take care of tooth deflections under load. While this procedure has at times brought good results, it has the objection of introducing another factor to be controlled in an already complicated cutting tool. My experience indicates quite strongly that modifications of the profile can be better performed through a running-in operation. This will, at the time, smooth the profiles, which is necessary whenever quiet gearing is desired.

Because of the sensitivity of spur gears to any change in profile, care must be taken to attain full control of the running-in operation. For this reason, only fine abrasives should be used.



Figs. 8 to 11 — Position of the bearing on the tooth profile is an important consideration in obtaining quiet gears

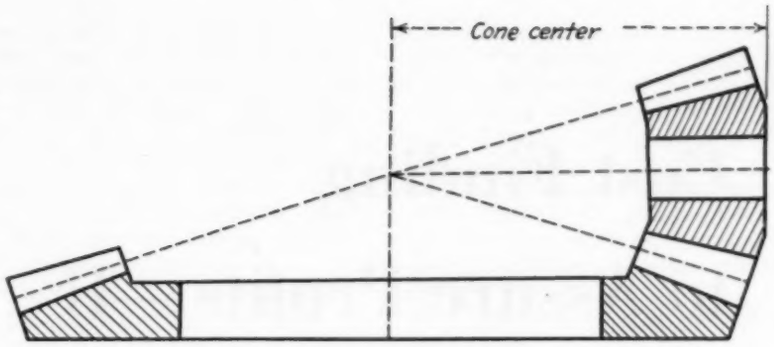


Fig. 12—To get the bearing high on the driver, a spiral bevel pinion should be cut with the cone center slightly long

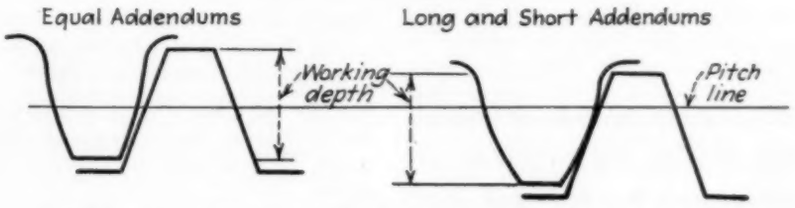


Fig. 13—Long and short addendums aid lapping by giving greater sliding action

Burnishing, (a running-in operation without the use of abrasive) is widely practiced.

The statement previously made relative to helical tooth profiles should not be taken to mean that control over this factor can be neglected in the operations preceding lapping. Nor is it the intention to minimize the importance of the various devices available for checking tooth profiles. It is quite necessary that control be exercised, as obviously uniformity of gears coming to the lap is desirable.

The difficulty encountered with profile measuring devices is that the unit of measurement is usually 0.0001 in., which classifies them more as laboratory instruments than everyday shop inspection tools. This statement will appear more logical when it is considered that the average pair of automobile gears has in the neighborhood of 50 teeth which means 100 profiles, that individual measurements are somewhat more difficult to ascertain than when dealing with plain or cylindrical surfaces and that such gears must be produced and inspected rapidly.

By measuring gear teeth before and after lapping, an indication of the lapping action can be ascertained; that is, if the gears have been lapped for an appreciable length of time, the difference between gears that meet and ones that just fail to meet the required standard is often represented by a small amount of lapping time. For example, gears have been lapped two minutes and failed to meet the required test for quietness; the same gears lapped twenty seconds more passing readily. When this occurs, the difference between gears before and after relap is so small that available instruments fail to show the difference to a degree which would permit designating practical tolerances.

Considerations as outlined in the two preceding paragraphs explain why attention has been focused upon the possibilities of lapping. They also show why the use of profile measuring devices are limited. I have found them to be of most service as an aid to research and in the inspection of cutting tools.

The accuracy of profile on cut gears depends largely on the accuracy of the cutting tools, and it is advisable to set the tolerances of the tools in a way that will not place an undue burden upon the lapping operation. In fact the possibility of a satisfactory lapping operation, which will not require too much skill on the part of the operator, is enhanced by maintaining the tolerances in direction that will make the tooth bearing high on the driver and low on the driven gear (Fig. 10 and 11).

To make the tooth bearing high and low on the driven and driver respectively, the base pitch (Fig. 6) is made wider on the driver than on the driven. In terms of this measurement, from 0.001 to 0.015 in. wide on the driver has been satisfactory for helical gears.

For spiral bevel gears high and low tooth bearings are checked as a function of a change in cone center distances (Fig. 12). Cutting the pinion teeth to show an even bearing when gears are mounted on a cone center which is long, will cause the bearing to be high on the pinion and low on the ring gear when mounted on correct cone centers. In terms of cone center change, cutting the pinion 0.008 to 0.012 in. long was found satisfactory. At first this may seem to be excessive, but the change in tooth profile is only a fraction of the cone center change.

Intentionally cutting the tooth bearing high on the driver or low on the driven through a change in base pitch precludes any possibility of quiet operation before lapping. However, a comparison of gear sets before and after lapping brought out the rather surprising information that the most quiet sets before lapping were not necessarily the most quiet after lapping.

Having the tooth bearing high on the driver has the advantage of leaving something in the way of an appreciable amount of metal to be removed at an important point, namely, the start of tooth engagement of the driver. Here the sliding action between the teeth is greatest; consequently, the metal is removed rapidly, and where the gears are mounted concentrically, the lapping tends to correct eccentricity and spacing at this important place. Further, the sliding action between the teeth is intensified by the practice.

Long Addendums Advantageous

Sliding action or slippage between teeth, which is present to some degree in all gear combinations, facilitates the lapping operation and can, within limitations, be increased or decreased through tooth design. A large percentage of automobile rear axle gears of the spiral bevel type are made with long and short addendums for the driver and driven respectively. This increases the slippage over that which occurs when equal addendums.

To make the teeth with long and short addendum, the outside diameter and root diameter are enlarged on the driver and correspondingly reduced on the driven. The amount of enlargement and reduction depends on a number of factors which requires a rather lengthy analysis if they all are to be considered. For the majority of axle combinations the Gleason Works recommendation of $\frac{1}{10}$ of the working depth (working depth equals the sum of the two addendums, Fig. 13) for the pinion addendum and $\frac{9}{10}$ for the driven gear is satisfactory.

The sliding action between the teeth is greatest at the outer edge of the teeth and diminishes as contact approaches the pitch line. Where the gears are long and short addendum, the pitch line of the driven gear is near the tops of the teeth, and when the tooth bearing is cut low, as previously recommended, contact does not take place at the pitch line until after a major portion of the lapping is accomplished.

Long and short addendum gears were originally adopted for axle combinations because the number of teeth in the pinion were small, often ten or less, and the design avoided undercutting the pinion flanks. It is interesting to note that this particular design was incorporated in the first automobile gears to be successfully lapped on a large production basis. So it is not without precedent that attention is called to the possibilities of the design for gears that are to be lapped and which ordinarily would be made with equal addendums, such as helical gearing for automobile transmissions.

The equipment for lapping spiral bevels, differs from that used for helicals in that the former are generally made with the tooth bearing localized, as in Fig. 14, which permits some deflection under load without concentrating the bearing on the large end of the tooth. For this reason they are oscillated during the operation so that the tooth surface is lapped toe to heel.

The oscillating motion is accomplished through the use of cams and other suitable mechanism on Gleason spiral bevel lapping machines. An interesting feature and one which serves to illustrate the possibilities of lapping, is that through the use of suitable dwells on the cams, the location of the tooth bearing can be changed. This permits some

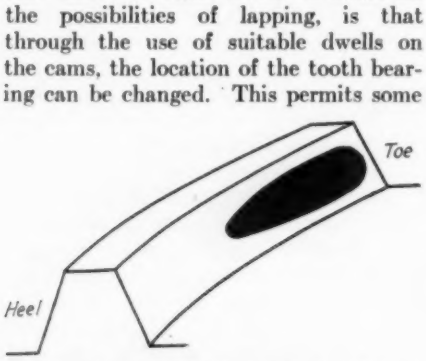


Fig. 14—Localized tooth bearing in spiral bevels permits some deflection without concentrating the bearing on the large end

variation in tooth bearing location which is likely to occur through heat-treatment distortions and yet have the final product uniform.

The necessity for a localized tooth bearing has not been as apparent in transmission as it was in axle design nor has heat-treatment distortions proved as critical a consideration. As a result helical teeth are not crowned. However, it is possible that future requirements will necessitate recourse to this type gear, and development of helical gears lays in this direction.

A lapping machine for crowned tooth helicals would not present many complications, as the fundamental requirements by the running-in method are quite simple. Further, the experience back of spiral bevel lapping lends almost complete assurance to its success.

Cost Finding to Assure Profits—II

CHARLES H. HATCH
Vice-president, Miller, Franklin & Company

New fundamentals are combined with old to form an integrated system that has proved its worth in practice

YEARS ago a certain shop was noted for the fact that all of the department heads and even the sub-foremen were every bit as keen on keeping their costs at a minimum as the president and board of directors could possibly be. Every department head was familiar with his operating and product costs and constantly on the look-out to better them.

Even the heads of the non-productive departments such as administrative, office, maintenance, power plant and the like, were as cost conscious as those in the productive departments.

Each Department a Unit

By what means were these executives and department heads kept on their toes in a constant striving after lower costs? Simply enough. Each department, non-productive as well as productive, was considered as a separate business. Each department was on a profit and loss basis. The executives and department heads were currently informed of their operating and product costs. Each department was credited on a commercial basis for its service or product. The department heads shared in the profits of their departments, and the general supervision and executives shared in the profits of the business as a whole.

Thus the real estate and equipment department charged each other department a fair rental considering location, amount of space occupied, amount of equipment used and so on. The rental was set to cover such items as depreciation, insurance, taxes, building maintenance and repairs, care of grounds and the like, on a basis which would permit the real estate and equipment department, if well run, to make a little money.

In the same way the power, heat and light department was charged with rent and all materials and labor, of whatever kind, it used. It charged other departments for the power, heat and light it furnished them on a commercial basis.

So it was with all of the non-productive departments. Profits and losses arising in these departments were not absorbed by the productive and distribution departments, but, rather, were credited or charged to the operating results of the business as a whole.

Each productive department was charged with all of its proper costs, most of them on a commercial basis. It was credited with its production on a commercial basis less a predetermined percentage to include selling, administrative, further processing if required, packaging, shipping and similar charges. This "commercial basis" was calculated to permit a commercial profit to the individual department for good practice and performance.

The distribution departments were charged with their proper costs and credited with percentages of sales plus a bonus percentage on sales profit above a predetermined amount. The first percentage acted as an incentive to maintain or increase sales volume, and the second acted to maintain or better the anticipated profit margin.

Of course, all departments did not always show a profit. Profits and losses were cumulated against each department.

It is evident that the algebraic sum of all departmental profits and losses would be the operating profit or loss for the business as a whole. It was in this profit that the general supervision and management participated.

Such a method of accounting and cost-finding was at the time ideal for the

business I have described. It is still basically sound and generally applicable —provided it is so altered as to make it inexpensive to operate. Many cost accountants and cost engineers have recognized the value of its basic idea, but have met disaster when they tried to use it, because they failed to overcome three major and generally fundamental obstacles. These are:

1. Few, if any, other businesses have stable commercial prices for most of their products in their various stages of completion as the one cited.

2. The detail required to maintain such a method would be prohibitive today in most businesses.

3. The continuous transferring of productive material costs from department to department is seldom practical. This is the principal reason for the unworkable complexity which has mitigated against the satisfactory use of this cost set-up in the past.

Modification Overcomes Obstacles

These obstacles have been overcome by combining the best features and ideas of the departmental profit and loss plan with simplified modern methods of accounting and cost-finding on a *source and unit basis*. The result, which is described in this series of articles, is a method which, with a minimum of clerical effort, provides sound product costs and current positive cost control.

To get the maximum good from the use of uniform accounting and cost methods, it is necessary to recognize and accept the following fundamentals:

1. All proper costs shall be included and uniform fundamentals followed.
2. Each and every department, whether productive, non-productive or distribution, shall be set up on a profit and loss basis.
3. Productive materials shall be considered on a unit basis, class by class, and not department by department.
4. All actual departmental figures shall be on an "added-value" basis.
5. The unitization of departmental cost elements must be the regular basis of departmental cost comparisons and control.
6. Detail figures must be available for analysis, if desired, although such detailed analysis should not usually be a routine function. It should be made only when actual performance varies unreasonably from the predetermined units.
7. The cost figures must be tied in with the books of general accounting.

Too many figures are confusing, serve no useful purpose, and are costly to correlate and tabulate.

The modern plan is to reduce the number of figures developed and shown to those that are pertinent, concise and useful. The practical way is to simplify the entire method of accounting.

Thus if an element of cost can be controlled from a source record, as often happens, that should be done in the interest of promptness and economy.

With these basic considerations in mind, let us see what are the chief objectives of uniform accounting and cost-finding.

The main objectives of uniform accounting are:

1. The inclusion of all proper charges and credits of a company regularly in the books of account.
2. The recording of these charges and credits in such a way that they may be handled in the most direct fashion possible from the books of original entry through the ledger to the periodic and annual statements.
3. To permit the regular compilation of periodic and annual cost records which will tie in with the books of general accounting.
4. To permit the ready preparation of periodic and annual statements of condition and operation in a uniform manner and in sufficient detail so that the activities and results of one company within a given industry may be compared directly with those of other companies in the same industry.
5. That under the NIRA, where the provision is made for an industry not to sell below cost, it can be directly determined whether or not each company in the industry is complying in fact and in spirit with this provision.

Cost Finding Goals

The main objectives of uniform cost-finding are:

1. The true portrayal of actual cost elements, labor, material, and manufacturing and distribution expense, against unit cost elements, currently to permit immediate source control.
2. The true portrayal of actual departmental and material costs against unit departmental and material costs periodically to permit reviewing, department by department, and class of material by class of material, the cumulative effect of current cost control.
3. The determination of unit product costs for
   (a) Current product pricing
   (b) Inventory cost pricing
   (c) The determination of product cost relation to selling price currently for sales control and promotion purposes
   (d) The establishment of the cost of sales periodically for inventory relief and gross profit determination.
4. To compile regularly periodic and annual cost records which tie in with the books of general accounting.
5. The recording and tabulation of only the necessary information and statistics in the most direct and simplest fashion for current and periodic use, at the same time permitting detailed analysis of any special information when desired.

Definitions and Distinctions

So far in this article we have been discussing fundamental principles. Now it becomes necessary to define specifically the terms and concepts to which reference will frequently be made in later articles. It is essential to digest and understand this information, so that the reader will have a common understanding with the writer in the use of terms. This is particularly important because certain terms, such as "direct" and "indirect", are given meanings of somewhat different scope from those in common use.

The following are the definitions with which the reader should be familiar:

1. Productive—that which has to do immediately with the progress of a product toward its completion. For example:
   (a) Productive department—a department in which productive materials are processed or furthered toward completion.
   (b) Productive material—material which is processed into a finished product or a material which is directly consumed in such processing and can be definitely allocated to the product.
   (c) Productive labor—labor, either direct or indirect, which acts in the processing of a product. All labor regularly employed in a productive department.

2. Non-productive—that which has to do, in a secondary or contributory fashion, with the progress of a product toward its completion. For example:
   (a) Non-productive department—a department in which little or no productive material is furthered or processed toward completion and whose regular function is to aid or serve productive or other non-productive departments.
   (b) Non-productive material—material which is not processed into a finished product or is not directly consumed in such processing and cannot be allocated to the product. Maintenance materials, supplies, construction materials, repair parts and the like are non-productive materials.
   (c) Non-productive labor — labor employed in non-productive departments.

3. Distribution—that which has to do

with the promotion, sale and distribution of the products and the satisfaction of the customer.

4. Direct—that which can be allocated directly to the product. For example: direct labor; direct material.

5. Indirect—that which can be allocated indirectly to the product. For example: indirect labor; indirect material.

6. Department—a distinct and logical cost subdivision of the business, usually having an individual head, supervisor or foreman.

7. Division—one of the three major cost segregations of the average business. For example: productive; non-productive; distribution.

8. Added value—this includes all labor and expense as they accrue in processing and selling, but does not include productive materials. In other words, it is all cost except productive materials. It is readily understood that all manufacturing is primarily interested in the *added value*—it is the very foundation of manufacturing.

9. Unitization—the studied and predetermined performance and result, resolved into a unit, which may be confidently expected labor-wise, material-wise or expense-wise for a given operation or series of operations, with given equipment under usual conditions.

10. Source—the use of statistical, accounting and cost data and information directly, or with the fewest steps possible, from the original or source tabulations for final recording and control purposes. In short, the elimination of every unnecessary step and figure, using totals wherever practical, so activities may be positively controlled currently.

Costs Not Based on Divisions

It is desirable to understand in more detail what goes to make up two of the three divisions named in Definition 7. The three are the non-productive division, the productive division and the distribution division. These divisions are set up for accounting, cost and other purposes because of the dissimilarity of functions.

It is not, however, practical to treat accounting and costs on a division basis. The division is merely a major classification, the subdivisions of which are called departments. The department is the practical subdivision for accounting and cost purposes. The intimate activities of a department are usually controlled by a single individual—the foreman. It is upon these department heads that management must rely for putting into effect the corrections and detailed betterments indicated by the cost controls.

The following departments are the usual subdivisions of the non-productive division of most metal-working companies. In some instances, further subdivision may be necessary. In others it will be feasible to condense them:

Administrative
General office
General factory
Fixed charges—(Depreciation and obsolescence; insurance and taxes; etc.)
Heat, light and power
General repair and maintenance
Experimental and research
Hauling
Receiving, storage and shipping
Tool making, repair and maintenance

The departmental subdivisions of the distribution division which are usually common to sizeable companies are:

General sales
Branches
Sales staff
Advertising
Exhibits and demonstrations
Installation
Warehousing, shipping and freight
Sales promotion

These departments are not as fixed as those in the non-productive division. They may vary materially to meet the requirements of various branches of the metal-working industry and of small, medium and large companies in any branch of the industry. It is important to stress here the need for breaking up the distribution division into a sufficient number of departments to give cost figures by proper classification and in sufficient detail to control intelligently distribution costs.

It is not practical to attempt to list here the departments into which the productive division may be subdivided. They will be influenced in each individual plant by the type of production—whether mass, job-mass, or job—by plant layout, by equipment arrangement, by supervision assignment, and by the size of the business.

It must be recognized that uniform accounting and cost-finding methods include all those phases of accounting and cost-finding which are common to all businesses within an industry and which can be set up on a uniform basis.

Only Details Vary

The detailed accounting and cost-finding procedures for individual businesses within an industry may vary. The detailed requirements of product costing and departmental cost control may actually be peculiar to each individual business. The degree of importance of the various control features may be different in individual businesses.

In setting up these uniform methods we are going a bit beyond the strict uniform side of the picture and showing the shortest, most direct and most practical procedures for arriving at uniform accounting and cost-finding results.

In general, little change will be required in existing cost methods to make them conform with those we advise. Current use of cost information, a reduction in detail and less expense in accounting and cost-finding will result.

An Unsolved Explosion

WILLIAM ANDERSON

One morning, upon starting up one of the turbine blowers in the heat-treating department of a large machinery manufacturing plant, a rumbling noise was heard in the blower casing, the noise continued into a series of explosions and finally the blower was blown to pieces. The attendant in a confused mind started up the spare blower and started to investigate the cause of the damage done to the first; in the spare blower casing slight explosions were heard, and before the attendant got this blower shut off, it was also wrecked.

Investigation revealed a slight odor of illuminating gas coming from the wrecked blowers. Checking up on the furnace gas valves, one was found to have been opened a bit, or perhaps it was not closed tight the night before; this open gas valve was located in such a place and piped in such a way that the escaping gas could back into the blower casing, if the furnace were not in operation. The results of the investigation revealed the reason for the explosion, the combustible mixture in the blower casing; and the means of igniting this explosive mixture was next to be determined.

The machinery manufacturers contended at first that the motor was defective and caused the trouble, which the investigators of the blower company proved to be not true. Then the probability of some mechanical imperfection permitted the rotor to strike the casing was investigated from the angle that a spark was generated in this way and ignited the mixture in the casing, but the fragment of the blower examined fail to show anything that would contribute to the generation of a spark.

Because of lack of evidence all further investigation was postponed indefinitely. The blowers had been in service about a year, and any flaw that developed must have had a recent origin. The blowers were quiet in running and developed the few ounces of pressure needed for the work to be done without ever giving reason to believe that binding or friction or loose parts existed.

The actual cause of the explosions was never found out and remains an unsolved problem. Perhaps some interested reader would venture an opinion.

EDITORIALS

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EDITORS

New Products are Needed

There is a crying need for new products that will appeal to those who have surplus funds. It arises from a changed attitude on the part of many buyers, even business executives, who would rather put surplus funds in home comforts than attempt to invest them. More of the automobile sales are being made for cash than for years. Many of the old ideas of thrift that were sadly shaken by bank failures have been transformed into a desire for concrete investment that will not disappear overnight and will give satisfaction to the family.

It is for this reason that manufacturers of refrigerators, oil burners and similar appliances have done and are doing such a large business. Air conditioning apparatus will increase rapidly in favor, and its manufacture represents a new industry which will find many new customers. There is still room for great development and simplification in this field. Radio is again enlarging its operations and even the once outmoded bicycle seems to have a new lease of life.

New products that have a popular appeal will do more to reduce the army of the unemployed than any one factor. When men are back at work cost-reducing machinery will extend the markets by making them available to greater numbers. But low prices mean little to those who cannot earn enough to maintain themselves and their families.

Will History Repeat?

Several years ago a lot of us voted for prohibition with the misguided notion that we were advancing the cause of temperance and doing away with the saloon evil. We woke up later to discover that temperance had suffered a serious setback and that the saloon had simply gone into hiding. Then we set about to retrace our steps through repeal and we seem to be in sight of our goal.

A few weeks ago our representatives at Washington, at the instance of the administration, passed an act intended to hasten the return of recovery, and to end certain very bad labor practices in a few plants.

Now, according to many observers, including Whiting Williams who has mixed with the unemployed and secured first-hand opinions, relations between the great mass of working people and their present or former employers are better than they have ever been in our history. The reason is to be found in the widely adopted policies of spreading work, and of recalling former employees before taking on new hands. Men feel that they have a stake in their old jobs and that they are going to get them back when times permit. There are exceptions, it is perfectly true, and they are deplorable.

As a result of this new attitude toward labor, disturbances of any importance have not been among our troubles during the depression. The old warfare between capital and labor, employers against trade unions, has died down almost to nothing. But with the coming of the codes, and the beginning of the hearings, we seem to have a different picture. Old feuds have flared up, unfortunate things have been said, old fears have revived.

Let us devoutly hope that in our efforts to help industry and provide jobs we shall not arouse the old animosities and repeat our costly prohibition experiment.

Repairs That Should Never Be Made

Railway maintenance costs can be materially reduced in two ways: by the use of more efficient machine equipment, and by the elimination of repairs that should never be made at all. The first method of cost reduction is probably more fully appreciated than the last. Railway traditions, both in management and in the shop, are largely responsible for most of the rebuilding of motive power that should be sent to the scrap heap.

There are two valid reasons for the scrapping of many old locomotives. The cost of repair is excessive and the older, inefficient classes of motive power should be eliminated as fast as possible. Keeping old types of locomotives in service handicaps the transportation department and requires the storage of spare parts that take up room and run into money. The fewer types of locomotives in service, the lower the cost of maintenance.

Intricate and dubious methods of accounting are largely responsible for many of the repairs that should never be made. Directors and managers frown on appropriations for new equipment but approve heavy expenditure for repairs, under the guise of economy. There have been cases where the "repairs" closely resembled the order of the disgruntled engineer who, after a troublesome run, wrote on his report "jack up the whistle and put a new locomotive under it." But the directors could point with pride to the money they did not spend on new equipment.

In common with many shops not on a production basis, railway shops are prone to spend time and money in repairing such parts as globe valves and the like, when it would usually be cheaper to buy new ones. It is difficult for men in shops of this kind to realize that they can frequently save money by scrap-

ping a part instead of repairing it. This is especially true of brass fittings where the price of scrap metal is usually high.

While no hard and fast rules fit every case, shop executives will do well to study the question of uneconomical repairs carefully. Where men must be kept for emergencies, repairs that are otherwise wasteful may be justified, for direct labor is seldom the greatest charge against a job. And, in addition to actual savings, the advantages of getting rid of obsolete machines, locomotives and parts must not be overlooked.

Unreasonable Delivery Dates

This is a time when consideration in the placing of orders will help all around. When an order has been hanging fire for six months it is a bit unreasonable for the buyer, and exasperating to the maker, to specify immediate delivery.

With the N.R.A. trying to regulate hours to secure the greatest good to the greatest number, no buyer should insist on deliveries that were based on conditions existing before a code went into effect. A little more haste in placing the order and a little more patience as to delivery will do a lot to help along the good work.

When the unreasonable customer is a large and supposedly patriotic department of the government, as was recently the case, the manufacturer has a right to be peeved. Nor was the peeve soothed on learning that the order was not for immediate use but for stock. Orders are especially desirable at this time, but "have a heart when setting delivery dates."

• CHIPS •

Washington—Already NRA ranks begin to waver, not because of "dead cats" hurled in its direction but because of honest differences of opinion . . . Dudley Cates, assistant administrator, departs, taking issue with General Johnson on the moot question of labor unionization . . . John M. Hancock, executive organizer, also leaves NRA to return to private practice . . . Two months' job still ahead to hear 700 codes now listed . . . Roosevelt urges American Bankers Association to extend credit to "blue eagle" firms . . . Hoover household signs consumer agreement . . . "Buy now" NRA drive now slated to start September 20 . . . R.F.C. Head, Jesse Jones, recommends sale of bank stock to government to extend partnership . . . Announcing $70,000,000 allotment for rivers and harbors, Secretary Ickes makes belated effort to spur public works program . . . says non-federal allotments may be cancelled if funds are not spent promptly . . . New York gets $37,500,000 for 38th Street tunnel . . . Work will be provided for 8,000 for four years . . . Machine tool dealers submit NRA code.

Foreign—Cuba, in the throes of another rebellion, seeks to establish a new government . . . Junta displaces DeCespedes and elects for president San Martin, one of its members . . . President assigns 29 U. S. warships to Cuban duty while weighing advisability of intervention . . . Nazis gather at Nuremburg in huge display of party strength . . . Hitler speeds plans to reduce German unemployment but boycotts begin to cause worry . . . Nazi influence seen in "leaves of absence" for New York and Chicago German counsels . . . Austrian manoeuvres near border regarded as anti-Nazi move . . . Soviet industry improves counter to seasonal trend . . . auto and tractor production increases . . . England loses noted industrialist by the death of Sir Gilbert Vyle, managing director of W & T Avery, Ltd. . . . Spanish Premier Manuel Azana resigns in cabinet upset.

Finance—U. S. Treasury permits gold bullion export and sets price of $29.12 . . . Brokers' loans for August show fifth consecutive monthly rise . . . Common stocks still below September, 1932, prices on a gold basis . . . N. Y. Exchange discontinues Saturday closing . . . Bankers assail deposit guarantee plan and ask postponement . . . R.F.C. authorizes loans of $98,892,523 to closed banks and $12,732,500 to buy preferred stock . . . Holders of Latin American bonds ask Federal cooperation . . . Detroit investigation kills prospects of reopening old banks . . . Federal income increases $62,110,182 in fiscal year 1933.

Industry—Eastman plans use of public works fund to aid railroads in equipment buying . . . C & O places order for 32,480 tons of rails . . . R.R. safety record is again marred by disastrous wreck near Binghamton, N. Y. . . . Local strikes in various trades continue to offset NRA employment gains . . . Code of fair practice is adopted by Chicago Board of Trade.

Indicators—Federal survey shows 267,607 families off relief in July . . . but 2,985,156 are still left on rolls . . . President tells National Citizens Committee that continuation of private charities is essential . . . Steel production falls to 45 per cent on *Iron Age* index . . . But Iron & Steel Institute report 8-month production exceeds that for all of 1932 . . . *Business Week* index drops from 64.6 to 62.8 . . . Wholesale prices are 17 per cent higher than February . . . August construction was 28 per cent better than July . . . Carloadings for week of September 2 increased 666,652 over preceding week and 105,327 over last year . . . Power consumption for the same period was 11.8 per cent above last year.

NRA Success Depends on Capital Goods Revival

New policy recognizes need of efficient manufacture to keep down costs. Construction to be stimulated

Washington—There is increasing realization at the NRA that something more must be done for the capital goods industries. A definite program to that end now is before the powers that be. This trend is propelled by two powerful influences. One is the desire to stimulate the industries that are responsible in normal times for half of the employment. The other is the desire to get production on a more efficient basis so as to reduce costs and lighten the burden the consumer is being forced to carry in the initial stages of the NRA program.

To lift the capital goods industries, including construction and machinery, out of their doldroms, a special section has been set up, under the Research and Statistical Division, headed by Dr. Alexander Sachs, and an intensive study of what can be done for this broad segment of American industry is being made. The early statements, in the course of hearings on such codes as that of the Cotton Textile Institute, that new plant would be discouraged, and of such recent codes as that of the refractories industry, which put a penalty on new equipment in an industry that has advanced, technically, far beyond its present plants, is now definitely out.

Although a positive statement on the equipment and capital goods situation has not yet been made, the demands of the situation, according to NRA economists, are imperative. It is pointed out that while the codes do not put any obstacles in the way of the replacement of old equipment, there is a definite tendency in some of them to penalize enterprise even in replacing old machinery, and this tendency must be stopped, if the most productive section of American industry is to have its chance to contribute to the general prosperity. The present is a capital goods depression, and the only way out of it is through a revival of the capital goods industries.

While the planning for the extension of credit to industry is still in the "study" stage, as the President puts it, the thought at present is understood to be revolving around the establishment of "mortgage" companies in a large number of localities which will indorse the notes of responsible concerns willing to undertake employment-making activities. The Reconstruction Finance Corporation would subscribe to the stock of the mortgage company.

It has been suggested that the mortgage company assume only a portion of any loss that may be incurred, allowing the bank to assume the remainder. Even that plan meets objection from those who think the banks still would be slow to make loans. The average banker is said to contend that those who cannot get credit today are those who are not good risks. With that philosophy apparently governing bankers, it is felt that the government agency will have to assume the entire risk if money is to be secured for enterprises that do not fall in the gilt edge class so far as risk is concerned.

The problem is primarily one of capital investment, and the late Federal Reserve figures show that for every dollar of new corporation issues in 1933, there were $82 in 1932, $13 in 1931, $36 in 1930, $49 in 1929. The government policy has stifled investment progressively, and the problem of a revival of capital investment remains definitely and increasingly a government function. The figures further show that the high level of July (99, preliminary) this year passed June (92, final) and promises to be the high spot for the entire year unless some definite move is made to lift the capital goods and construction industries out of their rut with some dispatch.

The hope is first that railway rehabilitation may be stimulated, and second, that machinery investments and replacements may be increased, but the first drive, from NRA at least, is to be in the construction field. There is a definite reason for the choice of construction, and primarily building construction, to lead the procession. This is due first to the low figures now shown for this field for July, 22 (preliminary) for all construction and 13 for residential construc-

• INDUSTRIAL REVIEW •

Although September business in the machinery trades started off well in a few localities, in general there is a recession from the July and August levels. The opinion is unanimous that the cause of the slowing down is the uncertainty connected with NRA codes. Labor unrest, traceable to the same source, is also a negative factor.

In the Eastern territory, Philadelphia, Boston and New York correspondents say that considerable business is in sight but is being held up until NRA problems are settled. The Navy is asking for bids on some machinery. Things look a little better in Pittsburgh where inquiry continues and a few orders have been placed. In Cleveland, also, there is reason for more optimism. Some orders are being placed and inquiries are strong. Sentiment is increasingly critical of NRA achievements and policies.

Detroit is naturally the first large city to try out operations under an NRA code. Sentiment toward the code is favorable although competitors are keeping close watch of each other for infractions. Supply business is holding up, but second hand machinery is interfering with business in new equipment. New automobile models are on the way and are expected to bring some orders. Cincinnati reports sentiment generally favorable to NRA, with some machine tool plants operating at about one-third capacity, others practically idle. Used machines are moving. Indianapolis is also favorable to NRA, except for the hard-shell Republicans some of whom "view with alarm," and there are hopes that September business will improve.

Although St. Louis business is much ahead of activity prior to June there has been a general slowing down and very little activity in machinery. A growing pessimism over NRA activity is noticeable. Chicago feels that the making of codes has kept plant managers from placing orders and looks forward to the completion of the formative period. Business is marking time. Milwaukee reports more favorable than unfavorable sentiment toward NRA and some improvement in machinery sales.

tion. Coupled with this is the recognition that the delay in putting the funds of the public works program into effect —a job over which NRA has no control—has slowed up recovery perceptibly. A billion and a quarter of funds has been allocated, but of this only 44 millions have been spent to date and of this only 19 millions in the last month up to August 25, which gives no sign of a speeding up.

The NRA plan is to find a way to get government funds to assist the building construction industry, through a plan which will answer the objection generally voiced that with the government paying wheat and cotton and hog farmers to limit construction, any plan to increase building construction and so, apparently, decrease real estate values and securities is unsound and illogical. The plan proposed is to subsidize not merely construction but demolition, with the view to getting away from the job of waiting for slow attrition and tax demolition to do the job. Demolition will meet a social need, by eliminating old and unsanitary dwellings, and an economic need by giving quick and immediate employment to a large number of men, chiefly in the unskilled groups.

The financial phase of the plan rests either with the R.F.C. or the public works program. Encouragement is taken from the statement of President Roosevelt this week that part of the job of R.F.C. is going to be to help finance the recovery. The legalistic difficulties of its investments in bonds and preferred stocks (except of banks) are recognized, and the proposed plan to encourage this upturn in the real estate section of the capital goods industries is conceived on the assumption that this can be handled by R.F.C., where for the moment the expenditure for machinery replacements and new equipment apparently run up against legal tangles. Beyond the present gesture, however, loom immense projects and broad plans for the underpinning of the recovery through putting the money into the great basic industries and the channels of employment which are at their heart.

Machine Tool Dealers File Code

On September 8, machine tool dealers presented their code of fair competition to the National Recovery Administration. The code establishes a 40-hour week with overtime not to exceed 48 hours a week permissible for three weeks out of each six months. Stores and service stations are to remain open 52 hours a week.

The minimum wage is $15 weekly with $2 less for apprentices. Unfair competition is covered by a broad statement that will be subject to specific interpretation by the Supervisory Agency. The code provides for gathering statistical information. It is sponsored by the Associated Machine Tool Dealers, 4026 Jenkins Arcade Building, Pittsburgh, Pa. The text follows:

ARTICLE I—PURPOSE

This Code is created to increase employment, reduce working hours, establish equitable wage rates, improve the standards of labor, eliminate unfair, wasteful and uneconomical competitive practices in the Distribution of Machine Tools and otherwise to carry out the policy, purposes and provisions of the National Industrial Recovery Act.

This Code is presented on behalf of Distributors of Machine Tools by The Associated Machine Tool Dealers, which represent Distributors whose sales constitute approximately 75 per cent of the total sales of these Distributors and is, therefore, representative of the Distributors of Machine Tools.

The Association imposes no inequitable restrictions on admission to membership therein. Terms of membership in the Association shall be the name as provided in the Associated Machine Tool Dealers Constitution and By-Laws, namely, an initiation fee of fifty ($50.00) dollars and assessments pro rata as funds are required.

Any Distributor of Machine Tools may participate in any endeavors of applicant in the preparation of any revisions of, or additions or supplements to this Code, by accepting the proper pro rata share of the cost and responsibility of creating and administering it, either by becoming a member of applicant, or by paying to applicant an amount equal to the dues from time to time provided to be paid by a member of applicant in like situation.

Any Distributor of Machine Tools desiring to participate in the provisions of the Code may do so by signing and delivering to the Secretary of The Associated Machine Tool Dealers, a letter in which the Distributor assents to all the provisions of the Code.

ARTICLE II—DEFINITIONS

For the purposes of this Code, a Distributor of Machine Tools shall be defined as an individual, firm, partnership, or corporation who sells to industrial consumers and is classified as follows:

(a) Machine Tool Dealer, an individual, partnership, firm or corporation who purchases Machine Tools from a Builder and resells to the User or other trade outlets, maintains an adequate selling organization and accounting system, and performs all other functions necessary for the sale of Machine Tools.

(b) Machine Tool Builder who sells direct to User.

(c) Manufacturer's Agent who sells direct to User for the account of Machine Tool Builders.

(d) Importer of Machine Tools who sells direct to User.

For the purposes of this Code, Machine Tools and Equipment shall be defined, metal working machines, including attachments and fixtures which perform generally the function of changing the form of metal by the use of cutting tools, abrasives, forming dies, rolls, etc.

The term "employee" as used in this Code shall apply to and include all persons employed in the Industry in the warehousing, shipping and transporting of Machine Tools, office and clerical help, but shall not embrace outside salesmen, executives and their staff, and watchmen.

ARTICLE III—MONOPOLIES

This Code, as well as any supplemental Codes or amendments thereto that may be filed and approved, is not designed to promote monopolies, permit monopolistic practices, or to eliminate or oppress small enterprises and will not operate to discriminate against them but will tend to effectuate the policy, purposes and provisions of the National Industrial Recovery Act.

ARTICLE IV—LABOR CODE

Under this Code it is especially provided that:

Employees shall have the right to organize and bargain collectively, through representatives of their own choosing and shall be free from interference, restraint or coercion of employers of labor, or their agents in the designation of such representatives, or in self-organization or in other concerted activities for the purpose of collective bargaining or other mutual aid or protection.

No employee and no one seeking employment shall be required as a condition of employment to join any company union or to refrain from joining, organizing or assisting a labor organization of his own choosing; and

Employers shall comply with the maximum hours of labor, minimum rates of pay and other conditions of employment approved or prescribed by the President.

To effectuate Articles IV, V and VI of the Code, employees of members of the Code may set up a commitee of three (3) of their own choosing.

ARTICLE V—MAXIMUM HOURS

On and after the effective date of this Code, no member of the Industry shall work any employee for more than forty (40) hours per week, excepting at inventory, and other peak periods employees may work forty-eight (48) hours per week for a maximum of not to exceed three (3) weeks in each six (6) months, and except outside delivery men and maintenance employees who may be employed forty-eight (48) hours weekly or more, if paid time and one-third for all hours over forty-eight (48) hours weekly, and except executives whose salaries exceed thirty-five ($35.00) dollars per week, executives' staff, outside salesmen and watchmen.

And not to reduce the hours of any store or service operation to below fifty-two (52) hours in any one (1) week, unless such hours were less than fifty-two (52) hours per week before July 1, 1933, and in the latter case not to reduce such hours at all.

ARTICLE VI—MINIMUM COMPENSATION

On and after the effective date of this Code, members of the Industry shall establish minimum weekly rates of wages for the Industry for a work week specified in Article V as follows:

(a) The minimum wage that shall be paid employees shall be at the rate of fifteen ($15.00) dollars per week, except that apprentice employees with less than six (6) months experience in the Industry may be paid at the rate of two ($2.00) dollars less for a work week.

ARTICLE VII—SUPERVISORY AGENCY

To further effectuate the policies of the Act, the applicant Organization, acting by or through any Committee, or section thereof, to which it has theretofore delegated authority, is hereby designated the Supervisory Agency, for administering, supervising and promoting the performance of the provisions of this Code by the Members of the Industry. Such agency may from time to time present to the Administrator recommendations based on conditions in the Industry as they may develop which will tend to effectuate the operation of the provisions of this Code and the policy of the National Industrial Recovery Act, and in particular along the following lines:

(a) Recommendations for the making of requirements by the Administrator as to practices by persons engaged in the Industry as to methods and conditions of trading, the naming and reporting of prices which may be appropriate to avoid discrimination, to promote the stabilization of the Industry, to prevent and eliminate unfair and destructive competitive prices and practices.

(b) Recommendations for dealing with any inequalities that may otherwise arise to endanger the stability of the Industry and of employment. Such recommendations, when approved by the Administrator, shall have the same force and effect as any other provisions of this Code.

(c) Such agency is also set up to—

1. Cooperate with the Administrator in making investigations as to the functioning and observance of any of the provisions of this Code, at its own instance or on complaint by any person affected, and to report the same to the Administrator, and

2. Recommend that the local group in each trading area set up a Trading Area Committee of one, two or three, for the purpose of carrying out the provisions of this Code, and

3. With the approval of a Trading Area Committee, take the necessary steps to set-up in the interested area, a trade-in plan to make available to the prospective purchasers of Machine Tools, having used equipment to dispose of, an outlet whereby they can secure the market price prevailing for same.

ARTICLE VIII—STATISTICS

In order to provide data for the administration of the Act and this Code, the Supervisory Agency shall gather, any and all statistical information from Distributors of Machine Tools which from time to time is necessary for the enforcement of this Code.

ARTICLE IX—UNFAIR COMPETITION

Unfair practices shall be deemed to be practices or acts which by subterfuge, concealment, misrepresentation, or by any form of discrimination result in selling below published prices, or in deceiving or misleading purchasers, or in misrepresenting the products of competitors. Any such unfair practice is hereby declared to be and to constitute an unfair method of competition.

ARTICLE X—GENERAL

This Code and all the provisions thereof are expressly made subject to the right of the President, in accordance with the provision of Clause 10 (b) of the National Industrial Recovery Act, from time to time to cancel or modify any order, approval, license, rule or regulation, issued under Title I of said Act, and specifically to the right of the President to cancel or modify his approval of this Code or any conditions imposed by him upon his approval thereof.

Such of the provisions of this Code as are not required to be included therein by the National Industrial Recovery Act, may, with the approval of the President, be modified or eliminated as changes in circumstances or experience may indicate. It is contemplated that from time to time supplementary provisions to this Code or additional Codes will be submitted for the approval of the President to prevent unfair competition in price and other unfair and destructive competitive practices and to effectuate the other purposes and policies of Title I of the National Industrial Recovery Act consistent with the provisions thereof.

Violation of any provision of this Code or any approved rule issued thereunder, is an unfair method of competition within the meaning of the Act.

This Code shall become effective ten days after its approval by the President of the United States.

And Still More Codes

Among the codes in the metal-working field to reach Washington recently are those for manufacturers of rock crushers, hand chain hoists, malleable iron, steel tubular and firebox boilers, anti-friction bearings, gas cocks and valves and fittings. Of these that of the rock crusher industry had a hearing on September 12 presided over by Deputy Administrator Malcolm Muir.

Weekly Earnings Still Low

According to an analysis of average weekly earnings and hours of work, made by the National Industrial Conference Board, further adjustments are necessary. The average wage received by unskilled male labor in 21 industries was $15.83 for June, 1933, as against $14.42 for May and $23.22 for the year 1926. Average hours actually worked per week were 43.1 for June and 39.4 for May of this year compared to 50.2 for 1926.

In foundries and machine shops, June 1933 weekly earnings were $15.35, while the figures for May were $14.55, and for 1926, $24.49. Hours worked in this industry were 37.6 and 33.4 for June and May of this year, respectively, and 50.0 for the 1926 average.

The Conference Board's conclusions are that while the trend is in the upward direction further increases in wage rates are necessary in order to meet the standard set by the President's Reemployment Agreement of $14 for a 35-hr. week. However, the figures show that foundries and machine shops are much nearer the requirements than the average of 21 industries. These figures of course represent conditions before the PRA or any of the industry codes became effective.

Warner & Swasey Gets Order for Giant Telescope

Contract for the design and construction of the new McDonald Observatory on Mt. Locke in southwestern Texas, containing the second largest telescope in the world and exceeded only by the 100-in. telescope on Mt. Wilson in California, has been awarded to The Warner & Swasey Co. Among the telescopes constructed by this company are the 36-in. Lick telescope in California, the 40-in. Yerkes telescope of the University of Chicago, the great 72-in. reflecting telescope in Canada, and the 69-in. Perkins telescope at Ohio Wesleyan University.

The actual design of the McDonald project has been done by E. P. Burrell, director of engineering of the Warner & Swasey Co., who has had under his supervision all of the telescopes built by the company during the last twenty-five years. The main features of construction will include steel work of a highly specialized nature, manufacture of optical parts which requires the utmost precision, an intricate system of anti-friction bearings, and a complicated system of electrical control.

The observatory, in which the telescope will be housed, will be a cylindrical steel structure 71 ft. high, surmounted by a hemispherical dome 62 ft. in diameter. Construction will be of structural steel with special alloy sheet metal covering on exterior and interior, including insulation. The observing floor, where the telescope stands, will be three stories above the ground. The two lower floors will contain offices, chemical kitchen, library, developing rooms, and sleeping quarters.

The entire structure will be built around the two massive piers which support the telescope. These piers alone require 450 tons of concrete and ten tons of reinforcing steel. The telescope is to be of the reflector type. It will be approximately 26 ft. long, and its

main feature will be a great mirror 80 in. in diameter, and weighing 5,000 lb. The raw material of the mirror will be Pyrex, a type of glass made by the Corning Glass Works. The grinding and polishing of this mirror will require about two and a half years, and will be done at the Warner & Swasey plant in Cleveland. Five secondary mirrors will also be required.

O'Leary Makes Plea for Capital Industries

During the hearings on codes for the Compressed Air Institute, the Heat Exchange Institute and the Hydraulic Institute, before Deputy Administrator Malcolm Muir on September 5, John W. O'Leary president of the Machinery and Allied Products Institute, appealed for prompt aid for the skilled factory personnel employed in the manufacture of capital goods.

Speaking for MAPI, representing industrial groups employing 350,000 men, Mr. O'Leary stated that "Contrary to the general opinion, the economic troubles in the United States have not been caused so much by consumer shrinkage as by the almost total paralysis of the capital goods industries of the country. Reliable figures show demand for consumption goods, those the ordinary consumer uses daily, has dropped only about ten per cent since the depression. On the other hand the demand for machinery, locomotives, equipment and other products of the capital goods industries has slumped more than 80 per cent."

"It is evident that if we are to have any new springboard towards recovery we can only look to the industries that have the greatest distance to come back.

"In submitting the three codes under consideration to-day we are thoroughly in sympathy with the position of the Administration that overproduction is dangerous and should be avoided. Yet we feel confident that after so many years of inactivity in most of our American industries and factories, there does exist an acute need for machinery replacement because of obsolescence, depreciation and other reasons.

"The railroads offer a splendid example. For several years now our locogreat quantities of raw and fabricated materials and who employ thousands of high waged workers have been at a standstill. It is shown that their output has dropped off 98 per cent of normal. In like fashion the demand for new freight cars has only been 8 per cent of normal. When it is figured that these are only two branches of capital goods activity in the United States that in 1929 did a business better than 15 billion dollars, the importance of encouragement of durable goods industries and sympathetic consideration of their position is evident.

Russian Relations to Be Surveyed by Committee

In order to throw light on basic facts regarding our relations with the Soviet Union, the American Foundation has organized a committee representing industrial and other groups to make a study of the whole question. Curtis Bok, who has been selected as chairman, states that the survey will include "the traditional policy of the United States in recognizing other governments; the debts incurred by the Czarist régime; the confiscation by the Soviet government of the property of citizens of other countries; the Russian counterclaims for damages resulting from the Allied intervention; the terms on which other countries have recognized the Soviet government; the trade agreements that have in some cases, accompanied, or followed, recognition; the terms of credit given on goods sold to Russia, including guarantees of payment granted by some of the recognizing governments; and of the possibilities in nature and volume of Russian trade."

English Employers Oppose 40-Hour Week

London—A pamphlet, *Unemployment: Its Realities and Problems*, has been published by the Engineering and Allied Employers National Federation, Westminster, S. W., and is no doubt intended to be a reply to the movement among British workpeople for a 40-hour week. It states that "the engineering industry of this country is emphatically opposed to the introduction of a 40-hour week," and draws attention to the fact that "the comparative failure of the Washington Convention of 1919 has, in fact, shown that international legislation for the regulation of hours is valueless so long as the restrictions it seeks to enforce can be interpreted in different ways by different countries. Nor can international legislation take such account of the great diversity of wages, standards of living and general economic conditions existing in different parts of the world as to insure equality of opportunity in manufacture and in trade."

The pamphlet is of value because it gives results of an inquiry undertaken recently in which data were obtained from about three-quarters of the total employing power of the federation, every section of which was represented. Comparison is made between March, 1928, and March, 1933, the latter being regarded as marking the depth of the depression, while March, 1928, is stated to be "generally reckoned as the best post-war year and therefore regarded as normal."

Comparing these two periods, the average employment for all classes of workpeople was 73.3 per cent. Laborers were least employed at 60.8 per cent., skilled workers come next with 67.8 per cent., apprentices 70.3 per cent., semi-skilled 74.2 per cent., boys and youths 75.2 per cent., others 82.3 per cent., and females 107.8 per cent. Thus for the last class a definite increase in employment is recorded. This is accounted for by the considerable increase in the employment of women in motor car manufacture and in electric lamp manufacture.

As compared with 1928, machine tool makers as a class were reported as employed up to 92.2 per cent. The lowest class was vehicle builders at 21.1 per cent., with marine engineers at 28.8 per cent., locomotive builders at 29.6 per cent., and textile machinery makers coming next at 53.3 per cent. But a considerable amount of work was at short time, the percentage on full time being 83.4 in 1928 and 65.5 in 1933.

Tool Engineers Compile Standards

Through its various standardization committees, the American Society of Tool Engineers is gathering data and established standards of general interest to its members. It is planned to compile this information in reference book form.

Other engineering societies or manufacturers that have developed and adopted standard products are requested to send information on them to A. M. Sargent, secretary of A.S.T.E.

Welding Contract Let for High-Speed Train

Lukenweld, Inc., a division of the Lukens Steel Co., Coatesville, Pa., has been awarded the contract by the Winton Engine Corp., Cleveland, Ohio, for the manufacture, in arc-welded rolled steel construction, of the complete engine structure for the 600-hp. Winton engine that will power the new 110-mile an hour light-weight passenger train of the Union Pacific system. The engine parts to be built by welding consist of the engine frame proper, the oil pan and twelve cylinder heads. The frame will require a high strength alloy steel and will be subjected to a radiographic examination to insure good welds.

Production Sessions Included in S.A.E. Meeting

Two sessions devoted to shop equipment and machine finishes in Chicago, August 28 and 29, were well attended. The three papers presented provoked lively and extended discussion. The sessions were among the most interesting ever held by the Production Division of the Society of Automotive Engineers. Joseph Geschelin, of *Automotive Industries,* brought out many phases of the much-discussed subjects of replacement policies, of overhead charges and cost accounting in general as they affect the production man. He pointed out that comparisons of prices of machine tools with 1929 was misleading because of the many improvements made since that date. Free engineering service, a machine paying for itself in one year, budgeting for machine replacement, allocation of burden according to hours of usage for a machine and many other points were freely discussed. One member advocated that machine replacement funds be set aside or allocated on a percentage basis, as is sometimes done in advertising. Then, though the appropriation is reduced in dull times, some still remains for new machinery. One job was cited where tool expense alone was eight times that of labor, while on assembly work overhead it was only 50 per cent, yet both operations carry the same overhead in some plants.

Frederick W. Cedarleaf, of the Buick Motor Co., in his paper, given during the session on gears and broaching, pointed out the methods in use and gave the ratio of cost between finishing by grinding and by lapping as about 5 to 1. Tolerances are now close, yet not all gears are quiet. Can better methods be devised to make more accurate gears should engineers demand them?

Discussion brought out many interesting experiences which indicate that gear-tooth inaccuracy is only one cause of noisy gears. A case was cited where ten gear sets were made to extreme accuracy, yet only six were passed as quiet. Another maker told of two cars using the same gear set. Sets which were rejected as being noisy in one car ran quietly in the other. It was the general opinion that overall accuracy, starting with the hole, was more important than extreme accuracy of any one factor. Rigidity of mounting, deflection of shafts under load, acoustics of the case or car, all play their part; yet too rigid mounting may of itself cause noise.

One discussor suggested using a tough steel, not hardened, mating with a high tensile bronze as a possible solution. Another found that noise was greatest when the gears were warm from load and felt that if the oil could be kept cool and perhaps forced between the teeth to insure an oil film at high speeds, that noise might be reduced. Too rapid heating of gears in hardening was blamed for a tendency to "dish" the gears and distort the tooth face. It was also suggested that gears should be tested for noise as they leave the hobbing machines to catch errors before the final operations. Running gears together at high speed was advocated as the best way to detect noise. Gears that measure to close tolerances can still be noisy. It was generally considered that with the present accuracy of gear production, the engineer could, by proper study and design of mountings, secure good results.

The other paper of the session, by C. E. Bleicher, Chrysler Corporation, on external or surface broaching, pointed out the possibilities that seem to lie ahead for this method of machining. In milling the same teeth must take both the heavy work of the roughing cut and also do the finishing, where but one cut is used. With the broach each tooth does the share of the work while the finishing teeth touch only clean metal and take a predetermined depth of chip. The author told of the work being done at the Chrysler and other plants. Other advantages are the elimination of the noise of milling and the cooling of the teeth after leaving the work.

Implement Exports Rise 20 Per Cent

July exports of American farm equipment at $1,053,095 were twenty per cent above the June total of $874,909 and nineteen per cent above the July 1932, figure of $881,243, according to the Commerce Department. With the exception of March, July figures were the high for this year.

Wheel tractors of 15 to 32 belt-hp. showed the greatest gain with 152 units valued at $109,071 exported compared with 49 valued at $48,493 for July last wear. Tracklaying tractor shipments also rose from 67 valued at $89,983 in July, 1932, to 112 valued at $188,633 this year.

While exports of grain harvesters and binders showed considerable decline, trade in miscellaneous harvesting equipment reached a total of $140,305 as against $82,743 last July. Threshers showed a surprising gain with July 1933 exports of 42 valued at $39,870 compared with 14 at $7,209 in July last year.

Navy Shore Projects Get $13,600,000

According to a recent announcement by Public Works Administrator Harold L. Ickes, an allotment of $13,600,000 has been made to the Navy Department for construction and repair work at shore stations and navy yards. Projects selected were those on which work may be begun without delay.

The Navy Department estimates that this program will provide 266,000 man-weeks work at the sites and 600,000 man-weeks away from the sites, a total of 866,000 man-weeks. The work will be under the Bureau of Yards and Docks.

Of the allotment $4,500,000 will be spent for construction and improvement at Pearl Harbor, Hawaii, including $380,000 for cranes for the repair basin, $125,000 for extension of foundry and $40,000 to complete improvement of the industrial plant; $1,010,000 at Pensacola, Florida, for plant improvements; $1,455,000 at Puget Sound, Washington, including $1,350,000 for the machine and electric shop; $549,000 at the New York Navy Yard, including $300,000 for replacement of two 40-50 ton traveling drydock cranes and $50,000 for extension of the structural shop; $168,000 at the Mare Island navy yard, California; $383,000 at the naval air station, San Diego, California, including $175,000 for the final assembly shop; $325,000 at the Washington, D. C., navy yard; $72,000 at the submarine base, New London, Connecticut; $100,000 at the Philadelphia navy yard to replace air compressors; $50,000 at the Naval War College, Newport, Rhode Island; $465,000 at the Norfolk, Virginia, navy yard; $40,000 at Coco Solo, Canal Zone, covering complete extension of the aircraft overhaul shop; and $575,000 at the Naval Academy, Annapolis, Maryland.

A.S.S.T. to Change Name

If the recent unanimous resolution of its board of directors is ratified by the membership, the American Society for Steel Treating will be renamed American Metals Society. Reasons given by the directors for the change are:

1. The society has long since extended its field far beyond the single aspect of steel treating;

2. Members of the society have often called the attention of officers and directors to the fact that considerable confusion has arisen from time to time because of the implied limitations of the present name;

3. The society's scope of activities include a great proportion of non-ferrous as well as ferrous interests, with the result that any name referring only to iron and steel would be unsuitable;

4. The name "American Metals Society" is in harmony with the society's purposes: To promote the arts and sciences conected with the manufacture, treatment and uses of metals.

Since the first move toward the change of name came from the members themselves, and since the directors unanimously approve, it is felt that the membership will bring the name "American Metals Society" into official use by about January 1, 1934.

Metal Treating Institute To Meet in October

During the National Metal Congress, at the Hotel Statler, Detroit, a second meeting of the recently formed Metal Treating Institute will be held on October 2 at 2 p.m. Formed last month in Chicago, this organization is working on an NRA code for firms engaged in commercial metal treating.

Officers of the institute are:

President—C. V. Scott, president, C. V. Scott & Son.

Vice-President—T. E. Barker, president, Accurate Steel Treating Co.

Treasurer—W. S. Bidle, president, W. S. Bidle Co.

Secretary—W. H. Eisenman.

• BUSINESS ITEMS •

The Vascoloy-Ramet Corp., North Chicago, Ill., was organized Sept. 1, for the manufacture of tantulum carbide and production of cutting tools utilizing the material. In this company are consolidated the experience and research developments of the tantulum-carbide manufacturing divisions of three companies: Vanadium-Alloys Steel Co., Fansteel Products Co., Inc., and Ramet Corp. of America, a subsidiary of Fansteel. Under the trade name "Vascoloy-Ramet" the above products will be sold through the Vanadium-Alloys Steel Co., its sales agencies and established agencies of the Ramet Corp. of America.

The Cedarburg Manufacturing Co., Cedarburg, Wis., recently acquired the property and patents of the American Electric Motor Co., formerly a subsidiary of the Splitdorf-Bethlehem Electrical Co., Newark, N. J. The Cedarburg Mfg. Co. will continue the manufacture of American-Electric motors in sizes from ½ to 30 hp. THORVALD HANSEN, formerly works manager of the A. O. Smith Corp., Milwaukee, is president and general manager, and CRAWFORD PEREGO is vice-president in charge of sales.

The Pierce-Arrow Motor Car Co., Buffalo, N. Y., has been purchased from the Studebaker Corp., now in receivership, and the management continues largely in the same hands. ARTHUR J. CHANTER is president, B. H. WARNER, vice-president in charge of operations and K. M. WISE, director of engineering.

The Clouse Machine Products Co., Indianapolis, Ind., has been formed to manufacture tools. Capital stock, 1,000 shares at $10 par. Board of directors is composed of R. W. CLOUSE, W. A. MITCHELL and J. C. GOODLET.

Organization of the Heat Transfer Products Corp., Huntington, Ind., for the manufacture and sale of radiators and other heat transfer devices, has been announced. The company will occupy an idle building of the Caswell-Runyan Co.

The De Vlieg Milling Machine Co., Jackson, Mich., has been organized to manufacture milling machines and milling units. C. B. DE VLIEG is the founder.

Reorganization of S. F. Bowser & Co., Fort Wayne, Ind., following severance of a refining contract with the Fuller-Johnson Corp., Detroit, is announced by S. B. BETCHEL, president.

The Morton Mfg. Co., Muskegon Heights, Mich., maker of draw-cut machine tools, has appointed LEWIS GIEBEL, 1501 Undercliff Ave., Bronx, New York City, as representative in the New York area.

The Chicago Pneumatic Tool Co. opened a branch office at 1028 Sixth Ave., South, Seattle, Wash., on Sept. 1. A. M. ANDRESEN is manager.

The R. G. Haskins Co., Chicago, has appointed W. G. NICKOL, 410 Mariner Tower, Milwaukee, as representative handling its complete line of flexible-shaft, screw-driving and tapping equipment.

• PERSONALS •

JOHN O. JOHNSON has established offices for industrial mechanical engineering service at 506 Mills Bldg., Pennsylvania Ave. & 17th St., Washington, D. C. Mr. Johnson is chairman, American Gage Design Committee, formerly chief of the gage division, U. S. Ordinance Dept., and a member, National Screw Thread Commission.

F. F. BRAND has been appointed assistant to the manager in charge of engineering, Pittsfield Works, General Electric Co.

• OBITUARIES •

EDWARD MEREDITH GRIFFITHS, founder of the firm C. W. Burton, Griffith & Co., at one time importer of American tools into Great Britain, died Aug. 20. Mr. Griffiths had been vice-president of the Machine Tool Trades Association, but retired in 1932. He was also chairman of Drummond Bros., Ltd., Guildford.

FRANK A. COLVER, 78, for the past half century owner of the Solver Machine & Iron Works, Frankfort, Ind., died of pneumonia recently.

THOMAS M. HARDY, 52, for 25 years a manufacturer of metal stampings at Pendleton, Ind., died recently. He had a wide acquaintance in the automobile industry.

CHARLES H. HARTLEY, 68, Hagerstown, Ind., part founder of what now is the Perfect Circle Co., maker of piston rings, died recently.

• MEETINGS •

NATIONAL ASSOCIATION OF FOREMEN. Annual convention. September 15-16. Akron, Ohio. E. H. TINGLEY, secretary. Refinery Bldg., Dayton, Ohio.

NATIONAL METAL CONGRESS AND EXPOSITION. October 2-6. Detroit, Mich. Under the auspices of the American Society for Steel Treating. W. H. EISENMAN, secretary, 7016 Euclid Ave., Cleveland, Ohio.

NATIONAL SAFETY COUNCIL. Twenty-second annual safety congress and exposition. October 2-6. Stevens Hotel, Chicago. National Safety Council, Civic Opera Bldg., 20 North Wacker Drive, Chicago.

American Machinist
REFERENCE BOOK SHEET

Properties of Bronze Bearing Metals

DATA on bearing metals have shown a considerable lack of consistency. This condition has been brought about because the methods of testing, composition, melting and pouring practices, and kinds of test specimens have been selected according to individual opinion. Moreover, disconnected investigations have been responsible for a multiplicity of compositions differing but slightly in their constituents. Narrow specification limits and increased cost have resulted.

An orderly investigation of the properties of the bearing metals, starting with the bronzes, was begun by a "Non-ferrous Bearing Research Group" organized by the Federal Mogul Corporation, Detroit. This group was composed of technical men from the various bearing metal manufacturers and was successful in interesting the Copper and Brass Research Association in a study of the properties of the bronzes. The work was done at the Battelle Memorial Institute. The data compiled are mainly shown in the accompanying tables of physical properties of six well-known alloys.

The first of the alloys studied is commonly known as "Admiralty Bronze" or "Gun Metal." It is one of the oldest bronzes used for bearing purposes, and it structurally is a complex metal with two constituents. These under the microscope are visible as a ground mass of copper containing some tin and zinc and a hard compound of tin and copper. Although, the strength of the bronze is suited for applications where loads are heavy, it should be used only where lubrication is exceptionally good or the motion is of a rocking nature. It is suitable for heavily loaded piston pin bushings or other similar purposes. A well-known specification for this metal is S.A.E. 62. Its machining qualities are not as good as with the leaded compositions because there is a marked tendency to tear.

One of the strongest and hardest of the lead bronzes is the well known 80-10-10 leaded bronze composition, similar to the specification S.A.E. 64. The three constituents are: A ground mass of copper containing some dissolved tin, a hard compound of tin and copper, and spots of pure lead scattered throughout. It can be used for average bushing application, and similar to the specification S.A.E. 64. conditions, but it should not be used where lubrication is known to be consistently poor. Cutting qualities are

Admiralty Bronze

Nominal Composition	Cu 88%	Sn 10%	Zn 2%
Spec. Limits	Cu 87-89	Sn 9-11	Zn 1.5-2.5
	Maximum Impurities .75		

Tensile Properties—Test Bar Casting—machined .505 in. diameter, 2 in. gage length

	Average	Maximum	Minimum
A. Strength—lb/sq. in.	48,400	50,600	46,500
B. Elongation—% 2 in.	47.9	58.0	40.5
C. Reduction in Area—%	41.0	42.5	39.1
D. Modulus of Elasticity x 10^{-6}	11.8	12.2	11.1

	Average	Maximum	Minimum
Brinell Hardness—10 mm. ball, 500 K.G.	64.7	67.7	59.0

Brinell hardness at elevated temperatures

Temperature—°F	75	150	250	350	450
Hardness	65.8	64.0	60.0	57.9	59.4

Compressive Properties—Specimen .944 in. dia. .850 in. high

Load to compress	.001	.01	0.10 in. per in.
Pounds per sq. in.	16,000	22,000	45,000

	As Cast	Compressed
Density	8.573	At 100,000 lb.—8.725

Resistance to Pounding—Specimen 10 mm. dia. 20 mm. high
No. blows to deform 1%—22, 5%—1,000

80-10-10

Nominal Composition	Cu 80%	Sn 10%	Pb 10%
Spec. Limits	Cu 79-81	Sn 9-11	Pb 9-11
	Maximum Impurities 1.5		

Tensile Properties	Average	Maximum	Minimum
A. Strength—lb./sq. in.	39,800	44,000	36,300
B. Elongation—% 2 in.	29.4	41.0	23.0
C. Reduction in Area—%	27.2	34.4	20.6
D. Modulus of Elasticity x 10^{-6}	10.5	12.2	9.5

	Average	Maximum	Minimum
Brinell Hardness—10 mm. ball 500 K.G.	63.6	68.2	59.4

Brinell Hardness at elevated temperatures

Temperature—°F	75	150	250	350	450
Hardness	63.6	61.1	58.8	55.7	58.1

Load to compress	.001	.01	0.10 in. per in.
Pounds per sq. in.	14,000	20,7000	42,000

	As Cast	Compressed
Density	8.820	At 100,000 lb.—9.080

No. blows to deform 1%—16, 5%—1,000

83-7-7-3

Nominal Composition	Cu 83%	Sn 7%	Pb 7%	Zn 3%
Spec. Limits	Cu 82-84	Sn 6-8	Pb 6-8	Zn 2-4

Tensile Properties	Average	Maximum	Minimum
A. Strength—lb./sq. in.	33,900	35,800	31,600
B. Elongation—% 2 in.	23.2	27.5	19.5
C. Reduction in Area—%	23.8	24.8	20.6
D. Modulus of Elasticity x 10^{-6}	10.4	11.4	9.5

	Average	Maximum	Minimum
Brinell hardness—10 mm. ball 500 K.G.	53.3	57.9	50.3

Brinell hardness at elevated temperatures

Temperature—°F	75	150	250	350	450
Hardness	53.3	52.3	51.5	49.9	49.8

Load to compress	0.001	0.01	0.10 in. per in.
Pounds per sq. in.	14,000	19,500	36,500

	As Cast	Compressed
Density	8.604	At 100,000 lb.—8.864

No. blows to deform 1%—6, 5%—225

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Properties of Bronze Bearing Metals

good. The alloy can be breached.

The alloy 83-7-7-3 is designed primarily for good casting and machining qualities and has found wide use as a general "all-around" bushing metal. Its frictional and wear properties closely approximate those of the 80-10-10 composition, although the strength, hardness and resistance to pounding are considerably lower. Its founding characteristics are excellent. In machineability it is one of the best of the bronzes, both broaching and high-speed turning.

70-10-20

Nominal Composition	Cu 70%	Sn 10%	Pb 20%
Spec. Limits	Cu 69-72	Sn 8-10	Pb 19-21
	Maximum Impurities 1.0		

Tensile Properties	Average	Maximum	Minimum
A. Strength—lb./sq. in.	31,300	33,700	28,900
B. Elongation—% 2 in.	15.9	17.0	14.0
C. Reduction in Area—%	14.6	16.3	11.5
D. Modulus of Elasticity x 10^{-6}	9.0	9.4	8.3

	Average	Maximum	Minimum
Brinell hardness—10 mm. ball 500 K.G.	59.6	68.6	52.8

Brinell hardness at elevated temperatures

Temperature—°F	75	150	250	350	450
Hardness	59.6	58.5	57.2	52.6	54.3
Load to Compress	.001		.01	0.10 in. per in.	
Pounds per sq. in.	14,500			36,000	

	As Cast	Compressed
Density	9.037	At 100,000 lb.—9.219

No. blows to deform 1%—15, 5%—760

85-5-9-1

Nominal Composition	Cu 85%	Sn 5%	Pb 9%	Zn 1%
Spec. Limits	Cu 83-86	Sn 4-6	Pb 8-10	Zn .5-1.5
	Maximum Impurities 1.0			

Tensile Properties	Average	Maximum	Minimum
A. Strength—lb./sq. in.	31,000	34,000	27,200
B. Elongation—% 2 in.	16.5	22.0	12.5
C. Reduction in Area—%	20.2	25.1	17.7
D. Modulus of Elasticity x 10^{-6}	11.0	12.8	9.5

	Average	Maximum	Minimum
Brinell Hardness—10 mm. ball 500 K.G.	52.2	53.4	50.9

Brinell hardness at elevated temperatures

Temperature—°F	75	150	250	350	450
Hardness	52.2	52.5	49.8	48.6	48.6
Load to Compress	.001		.01	0.10 in. per in.	
Pounds per sq. in.	14,500		17,500	34,500	

	As Cast	Compressed
Density	8.815	At 100,000 lb.—9.006

No. blows to deform 1%—5, 5%—65

70-5-25

Nominal Composition	Cu 70%	Sn 5%	Pb 25%
Spec. Limits	Cu 68.5-71.5	Sn 4-5	Pb 23.5-26.5
	Maximum Impurities 1.0		

Tensile Properties	Average	Maximum	Minimum
A. Strength—lb./sq. in.	21,100	21,800	20,000
B. Elongation—% 2 in.	15.7	17.5	13.5
C. Reduction in Area—%	15.7	17.0	14.2
D. Modulus of Elasticity x 10^{-6}	7.0	7.4	6.7

	Average	Maximum	Minimum
Brinell Hardness—10 mm. ball 500 K.G.	42.1	42.7	41.3

Brinell hardness at elevated temperatures

Temperature—°F	75	150	250	350	450
Hardness	42.1	41.3	39.9	38.0	38.1
Load to compress	.001		.01	0.10 in. per in	
Pounds per sq. in.	10,000		14,000	26,000	

	As Cast	Compressed
Density	8.898	At 100,000 lb.—9.334

No blows to deform 1%—3, 5%—23

Alloy 70-10-20 is a comparatively recent development but is one of the hardest of the very high lead bronzes. Structurally it is the same as the 80-10-10 composition except the quantity of lead visible is very much greater. It is quite hard and the resistance to pounding is greater than any of the bronzes containing equal or higher lead content. Because of 20 per cent lead content, this alloy may be used safely under adverse lubrication conditions, even though moderately heavy loads prevail. Care should be exercised in broaching.

Otherwise known as S.A.E. 66, the alloy 85-5-9-1 is a modification of the 80-10-10 composition. Because of its low tin content its structure shows but two constituents; a ground mass of a solution of tin and zinc in copper, in which are distributed particles of virtually pure lead. This alloy is widely used for babbitt-lined bearing backs and for bushings where service is not severe. It has about the same bearing qualities as the 80-10-10 composition, but because of lower strength and lower resistance to pounding it should not be used under heavy loading. It machines easily and is inexpensive.

Composition 70-5-25 is known as "Journal Bearing Metal" for railroad use and is one of the oldest of the high-lead bronzes. The structure of this alloy is similar to the 85-5-9-1 composition, except that the visible lead is very much greater in amount. It is one of the weakest of the bronzes, having a hardness but little above the upper limits for the hardest babbitts. However, because of the very high lead content, this alloy may be used in bearings where only occasional lubrication is possible. Where low speeds and light loads obtain it has been known to serve for a considerable period without lubrication. It is a standard metal for bushing under-water shafts. The alloy cuts easily but requires great care in broaching to prevent deforming.

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Metal Cutting Research

The cutting of metals is fundamental to the building of machinery of all kinds. The shape and size of tools, the speeds, feeds and cuts that give greatest efficiency are vital to economical production. With these principles in mind the sub-committee on Metal Cutting Data, under the chairmanship of King Hathaway, has begun critical study of the available data under the auspices of the Special Research Committee on the Cutting of Metals of The American Society of Mechanical Engineers.

Beginning with the extensive experiments under the direction of Frederick W. Taylor, the studies so far made include the tests at the U S. Bureau of Standards as well as those made in Manchester, England, and in Sweden by Forsberg. Nor has the work of Boston and others in this country been overlooked. Using the available data from these various sources as a base, the subcommittee has compiled and charted the results obtained. This has been made difficult in some cases because of various methods used in making the tests. Taylor, for example, used the diameter of the piece being turned ahead of the tool in calculating cutting speed. The Bureau of Standards took the diameter at the bottom of the cut while the Manchester tests considered the diameter as the mean between the two. Translating the various results into similar terms has taken much time but has been necessary in order to compare results.

Most of the data available refers only to rough turning carbon steels and cast iron and does not apply directly to modern alloy steels, alloy cast irons, cast steel or non-ferrous metals. This is also true of the work in England, and in Sweden, and leaves us without consistent data as to finishing cuts even on the older materials.

The effect of variations in the size and shape of tools used has been calculated mathematically so as to be able to compare results from tests of different experiments. Encouraging results have been secured but further work must be done to avoid possible errors in such comparisons. With few exceptions, all research has been based on a single shape of tool nose. Taylor, however, developed elaborate formulas that included the nose radius as well as the effect of feed and depth of cut.

The Manchester experiments, while based on a given size and shape of tool, took into account the variations due to changes in the size of the tool, the nose radius and the cutting angles. Ragnar Woxen developed a formula which was intended to apply to any shape of tool, but he does not appear to have carried it to a point where it could be used generally. In other words, it represents a possibility rather than a conclusive solution of the problem.

Tool size, as well as the kind of steel and the heat-treatment used, has been found to affect the results to an appreciable extent. Experiments seem to indicate that many tools would be improved by heating to a higher temperature than is commonly practiced or even recommended by the steel makers. Then, too, some tools are not left in the furnace long enough to be heated clear through, which affects their efficiency in use.

Tool life between grinds is also an important factor that is not always correctly interpreted. The most economical life from the standpoint of efficient production may be much less than when the tool alone is considered. Taylor, it will be remembered, came to consider a 90-min. life between grinds as most efficient in average lathe work. The economical life bears a direct relation to the time required to change tools and to grind them, and of course varies widely between an engine lathe and a machine where several tools must be set with relation to each other. There are indications of a definite relation between the time required for grinding and changing tools and the economic point at which they should require replacement. In other words, it may prove more efficient to wear out tools than to prolong their life by slower speeds and feeds.

So far little has been done with the cutting of non-ferrous metals. This is to be regretted as they form a large proportion of the materials used in the electrical and some other industries. It is believed that much valuable information can be secured in these fields. Nor has drilling, a very important machinery operation, received the attention it deserves. While we have had lengthy tests on power and pressure required, the effect of speed on drill life and the most efficient feeds have not been determined in general, long run tests. Some of the progressive drill makers have given us the best data so far obtainable in this field of research.

Investigations so far made indicate a wide use of the 18-4-1 high speed steels and a tendency to add up to 5 per cent of cobalt. The cobalt seems to make the steel less sensitive to heat-treatment and to give an increase in efficiency. Heat-treatment is found to be a very important factor in efficient machining and both furnaces and heat control are vital in securing the best results. The sub-committee feels that real progress has been made but that much remains to be done that will be of great benefit to all who machine metal in any way.

Taming the Molecules

Whoever coined the phrase about the "cussedness of inanimate objects" didn't know the half of it. They also have their moments of cooperation if you stroke them the right way. At least we have this on the word of a doctor of philosophy who has developed a mechanism that will materially change the map of metal forming when, and if, it finds its place in the production line.

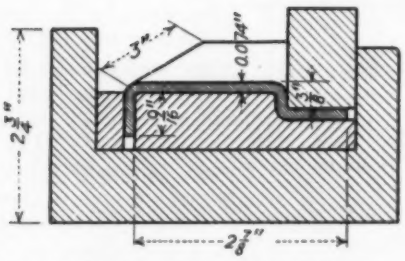
The usual machine for punching and forming metals is a brutal affair, entirely without finesse. It not only has to overcome the physical resistance of the metal but the opposition of the highly enraged molecules in and near the affected part. As the descending punch approaches the sheet or plate it encounters a mass meeting of protest among the molecules which throws monkey wrenches into the gears, figuratively speaking of course, and though they may not stop the punch in its passage through the plate, they seriously interfere with its peaceful progress.

These same molecules can, however, either be cajoled into peaceful cooperation or awed into a passive, non-resisting attitude. At least that's the story. When the properly designed machine starts to do its job of forming or punching, the molecules see that resistance is futile, perhaps murmur a vibrant "wa't'ells the use," and allow themselves to be sheared, bent or otherwise maltreated without putting up a fight. All of which adds to the life of the punches and dies, is easier on the machine and cuts down the power bills.

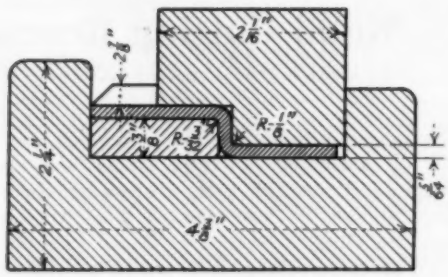
Anyhow it's a beautiful theory, and reflects credit on the imagination of the inventor. Next!

Press Work Pressures

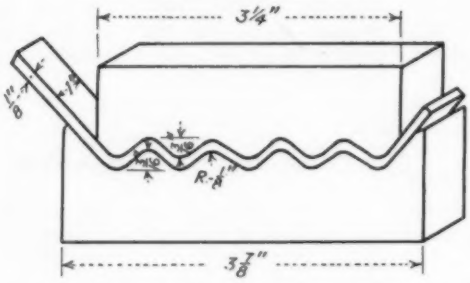
Series XV—*Forming*



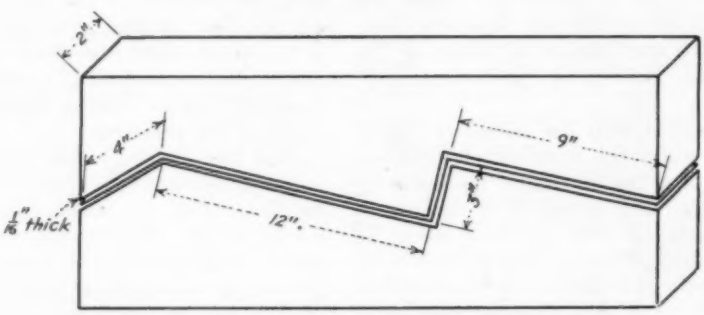
Material--Soft machine steel, 0.074 in. thick by 3 in. wide
Operation--Form as shown
Pressure--10,000 lb.



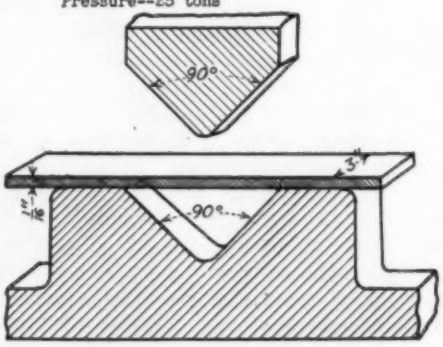
Material--Machine steel, 5/64 in. thick by 2-7/8 in. wide
Operation--Form as shown
Pressure--6,000 lb.



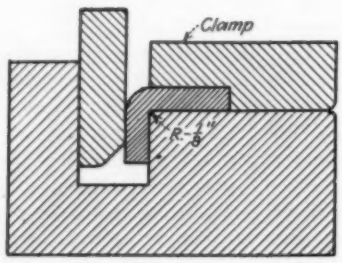
Material--Machine steel, 1/8 in. thick by 1 in. wide
Operation--Form as shown
Pressure--25 tons

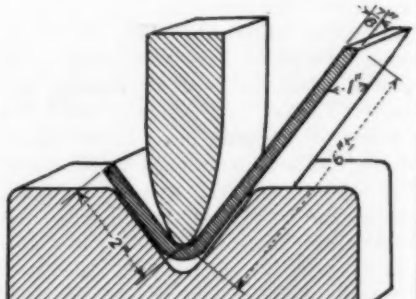


Material--Soft steel, 1/16 in. thick, 1 in. wide, 28 in. long
Operation--Form as shown
Pressure--8,000 lb.

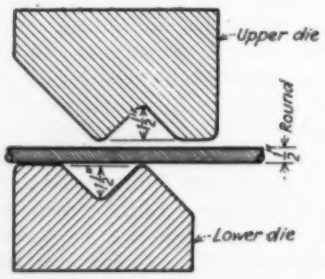


Material--Cold rolled machine steel, 1/16 in. thick by 3 in. wide
Operation--Form an angle of 90 deg. Work done cold
Pressure--12,000 lb.

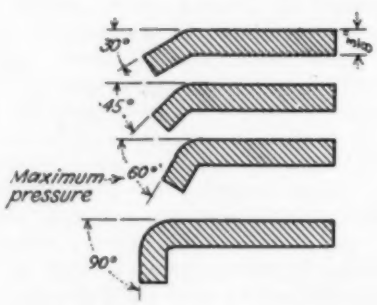




Material--Machine steel, 7/8 in. thick by 1 in. wide
Operation--Form into shape cold
Pressure--45,000 lb.



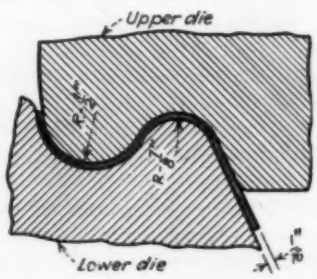
Material--Machine steel,
A-1/2 in. round rod
B-5/8 in. round rod
Operation--Form into shape cold
Pressure--A-20,000 lb.
B-30,000 lb.



Material--Machine steel, 3/8 in. thick

	1 in. wide	2 in. wide	3 in. wide
30 deg. angle	2,600 lb.	4,100 lb.	6,500 lb.
45 " "	3,900	5,200	8,000
*60 " "	7,500	10,500	17,500
90 " "	7,500	10,500	17,500

*Maximum
Test made in testing machine



Material--Machine steel, 1/16 in. thick by 1 in. wide
Operation--Form as shown
Pressure--1,500 lb.

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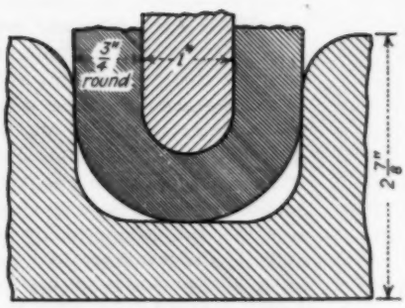
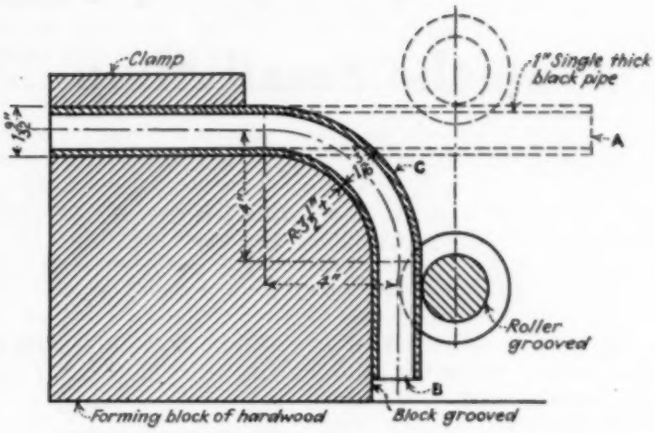
Press Work Pressures

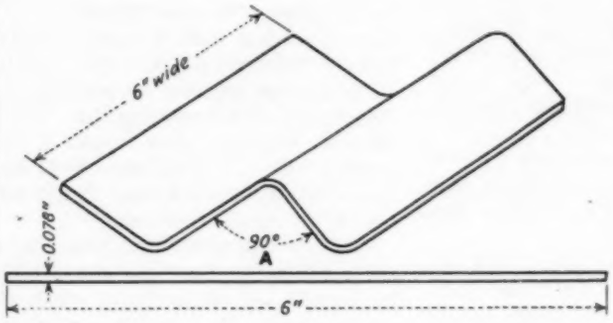
Series XV—*Forming*



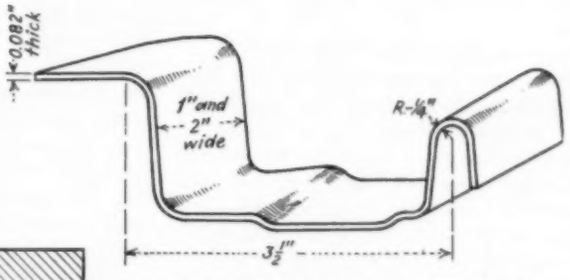
Material--Machine steel, 3/4 in. in diameter
Operation--Formed cold in flat dies
Pressure--7 tons



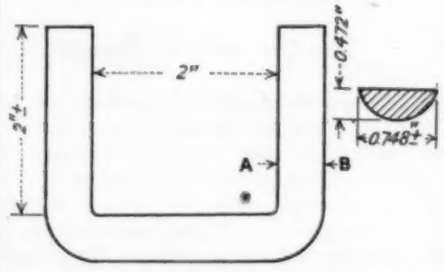
Material--Black iron pipe, 1-9/32 in. O.D.
Operation--1 in. thick plates put on both sides of forming block to keep pipe from widening out; flattened about 3/32 in. at "C". This work done cold, pipe not filled.
Pressure--3,000 lb. to form the pipe-end A to B



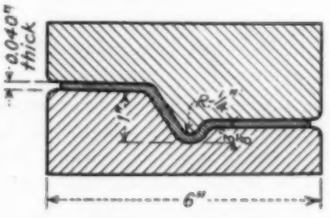
Material--Soft sheet steel, 0.078 in. thick by 6 in. long
Operation--Form into shape as at A
Pressure--10,000 lb.



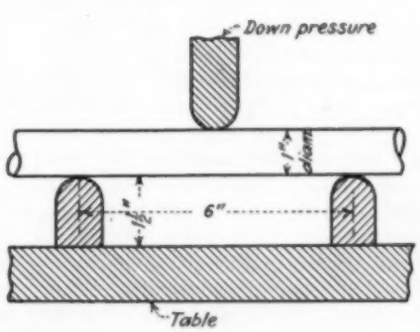
Material--Soft machine steel, 0.082 in. thick,
A- 1 in. wide
B- 2 in. wide
Operation--Form the piece in one stroke
Pressure--A-7,000 lb.
B-16,000



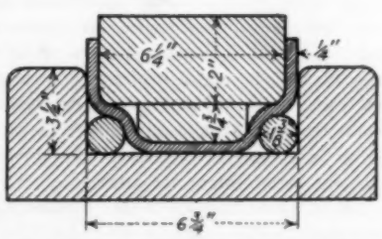
Material--Machine steel, 0.472 in. thick by 0.748 in. wide
Operation--Form a spring clip
Pressure--25,000 lb.



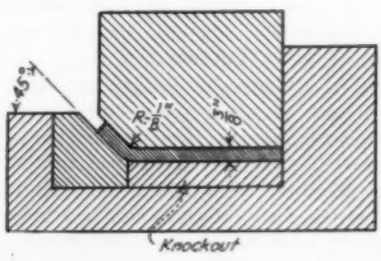
Material--Machine steel, 0.040 in. thick by 1 in. wide
Operation--Form as shown
Pressure--2,200 lb.



Material--Round tool steel,
A-1 in. diam., unannealed
B-2 in. diam., unannealed
C-1 in. annealed
D-1-1/4 in. cold rolled machine steel
Operation--Bend as shown
Pressure--A-6 tons
B-40 tons
C-4 tons
D-9 tons



Material--Machine steel, 1/4 in. thick by 1 in. wide
Operation--Form as shown
Pressure--30,000 lb.



Material--Machine steel, 3/8 in. thick by 3 in. wide
Operation--Form an angle of 45 deg.
Pressure--25 tons

Contributed by C. W. LUCAS © *American Machinist*

Milling and Shaping in the Small Shop

A. L. DE LEEUW
Consulting Engineer

THE PROBLEM of what kind of machine is the best for this or that job, is of special interest to the small shop. The particular question mentioned by Geo. D. Taylor (*AM*—Vol. 77, page 427), as to whether the shaper or the miller is the better machine to use for the job, has many different possible answers, and every one may be a good one. It depends on so many different things that no general rule can be given.

Let us keep in mind, in the first place, that the shop is not interested in the cutting time alone, nor in the time from floor to floor. What it is interested in is the time from *beginning to end* of the job. There are other points of interest, but this is the principal one.

And so, if you have to set up a milling machine for the job, adjust for the proper feed and speed, get the cutter and the proper arbor, remove the arbor that is in the machine, put the new arbor in place, hunt for the outboard support and put it on the machine, put the vise on the table, and arrange the oil pipe—you have a job on your hands, even if you do no cutting at all. If, at the same time, the shaper has been standing there ready for the job, with the proper tool in place because the same tool had been used for the previous operation, there can be no question but that the shaper is the machine to use.

If, at the same time, the shaper is standing idle but the miller has a job on it which will last for a day or two, and the customer is in a hurry, then the shaper must be used regardless of anything else.

However, all this is taking many things for granted which may not be so at all. Let us see what might be done with either machine. Let us see what the machine and the tool can do to the steel plates and then let the man who has the job decide which method fits this case.

Eight Ways of Using the Miller

1—Use a 4-in. helical mill 5 in. long. Put all twelve plates in the vise and cut the entire amount in one cut. This can be done with this kind of cutter. Cutting speed 70 ft., which calls for 67 r.p.m. Feed 0.030 in. Total travel, 16.2 in. Number of revolutions for this travel, 540. Time, 8 min.

Maybe you do not have such a cutter or a machine powerful enough to take such a cut. I am merely stating a possibility.

2—Do the same as before, but use stream lubrication. Under those conditions you can use 400 ft. cutting speed instead of 70, and the time will be 1.41 min. Maybe your machine is not arranged for stream lubrication, or, perhaps, you do not have the proper shield for this size cutter, but doing the job this way is one of the possibilities.

3—Use a spiral mill 4 in. in diameter, 5 in. long. Angle of spiral, 25 deg. Take four cuts each ¼ in. deep. Feed 0.030. Use stream lubrication. Speed 600 ft. per minute, which calls for 573 r.p.m. Time for one cut, 1.06 minutes, and for four cuts, 4.25 minutes. Add a couple of minutes for return and starting, and we can call the total time 6½ min.

Maybe your miller has no speed above 350 r.p.m., or even less. If not you can't make this time.

4—Without stream lubrication, but with the same cutter, the cutting speed will be 70 ft., and so the cutting time is increased in proportion of 600 to 70. This makes the time per cut 9.1 min. and for the four cuts 36.4 min. Add a couple of minutes for start and return, and the time from floor to floor is 39 min.

5—Use an 8-in. face mill. Cutting speed, 70 ft. Feed, 0.040. Approach, ¾ in. Total length of cut, 15.75 in. Depth of cut, ½ in. Number of revolutions per minute, 34. Number of revolutions required for one cut, 394. Time per cut 5½ min., and for two cuts 11 min. Add 1½ min., which makes the total 12½ min.

6—Use same cutter, but the blades tipped with tantalum carbide. Speed can be 150 ft., but feed should be reduced to 0.030. This would make the time for one cut 3.75, and for two cuts 7.5 min. Adding 1½ min. makes the total for the work 9 min.

7—What can be done with one saw has been described by Mr. Taylor, except that he did not mention the method of stream lubrication and this is really outside the problem he analyzed. However, as I am mentioning possibilities regardless of whether they are practical methods for the problems on hand or not, we should consider this method also. In that case, cutting speed may be 600 ft. As I am considering the best conditions for each method, I will take for granted that the saw can be keyed to the arbor. We must therefore use a saw of not less than 4 in. in diameter. Number of revolutions, 573. Number of revolutions required for one cut, 540. Time per cut, a little less than 1 min. Time for replacing work, approach, etc., another minute. Total time per plate, somewhat less than 2 min. Total time for 12 plates, about 22 min.

8—Place two plates simultaneously in the machine so that the strips which have to be cut off face each other, and use two saws. By using stream lubrication, we can use the same speeds and feeds as before, and cut the time in two. Total time, about 11 min.

The Question of Quantity

These eight different methods do not exhaust all possibilities, but they are enough to show the wide variation in time when conditions call for either one or the other method.

The principal thing which stands in the way of using some of these rapid methods for the particular job under discussion is that the quantity may be too small, and another is that such jobs are naturally done in the smaller jobbing shops only, where machines and tools for rapid production are generally not available. However, a number of instances have come under my observation which show that preconceived notions or lack of thought play as much of a part as the absence of powerful machinery or adequate tools.

In a certain tool room, principally occupied with making dies for punch presses, several hundred pieces of tool steel, all of the same width and thickness but of varying lengths, had to be finished on four sides. Heretofore, only a few pieces used to be finished at a time; just enough for one die. But the

tool room foreman conceived the idea that, as such pieces were being used practically all the time and for a great variety of dies, he might just as well make up a large quantity and keep them in stock. This would cheapen the making of the pieces somewhat, and expedite the making of dies. Up to this point it was a good idea. Unfortunately, he stopped at that point.

When only a few pieces had to be machined, the work was always done on the shaper, as the set-up time for the milling machine would be more than the total time required for two or three such pieces. Now, when he had more than 600 of these pieces, he was still doing the job in the same way. In this case the set-up time was a negligible percentage of the total time required for the job, and the whole job could be done on the miller in a small fraction of the time required by the shaper.

Using the Shaper

1—Use the method as described by Mr. Taylor in his discussion.

2—Use the same method, but with a multiple tool, the kind of tool that is often used on planers and where three or four tools are set in a common holder so that each succeeding tool takes a cut next to the cut taken by the preceding one. This would lengthen the stroke about 4 in., making the total stroke 20 in., so that the number of strokes per minute will have to be reduced to 25. Using the same feed per tool, the number of strokes will be ¼ of that used by Mr. Taylor, or about 24, which means that the entire cut can be done in one minute, making the total time for one cut about 1½ min., and for the entire work about 6 min.

3—If the tool were tipped with tantalum carbide, a further reduction could be made, whether a single or a multiple tool were used.

That the shaper may not have sufficient power, or that the stroke is not sufficient is neither here nor there. It shows what can be done with a shaper if the proper machine and tool are used.

The correct selection of machine and tool for a given job is, as a rule, a complicated problem and requires considerable thought and often considerable time. This is especially true because, in many cases, the necessary data that would enable a man to do his planning in the proper way are not at hand. Records of the possibilities of the various machines in a shop are not always kept up to date, and often are entirely lacking. That this is so is clearly indicated by the fact that a number of shops doing the same operation on the same kind of material or even on the same pieces will do it in different ways.

How About Toolmakers?

C. B. COLE
President, Tool Equipment Sales Company

Shop managers and employment men are likely to be faced soon with a shortage of good toolmakers. Good men who have been laid off have secured jobs elsewhere or have quit the trade entirely because of the low wages paid for highly skilled work. Machine operators, many of whom cannot set up their own machines, frequently have made more money than the best toolmaker. Furthermore, the toolmaker has an investment of from $100 to $300 in tools while the machine operator probably doesn't even possess a steel scale. Eyesight, too, plays an important part in toolmaking.

Most managers expect to find all the good men they need, waiting and anxious for jobs. Shops that have begun to hire men again are not finding the good men they counted on. Operators and one-job men may be plenty but toolmakers and all-around machinists promise to be scarce enough to demand, and get, much higher wages than before.

To assure an adequate source of supply of expert toolmakers and all-around machinists, it will be imperative for the metal working plants of this country to establish practical and thorough apprenticeship training systems for toolmakers and machinists. Each plant must do its part, or there will not be a sufficient number of skilled men available when required. A survey of the metal working plants of this country would prove that there are not enough toolmakers and machinists to meet ordinary requirements in anywhere near normal conditions. A large majority of the metal working plants do not have a practical apprentice system, many none at all. Some of these plants have an apprentice training that in reality develops toolroom machine operators such as lathe hands, grinders, or milling machine operators, etc., but no expert all-around tool and diemakers. These plants evidently expect other plants to develop toolmakers for them. When the majority of metal plants adopt this attitude, it is apparent that a shortage of skilled men will result. Some, we understand, are discharging apprentices because of the new minimum wage law. They will find this to be a short-sighted policy.

Up to the time of the recent restrictions on immigration, foreign toolmakers supplied much of the demand. With this supply shut off the metal working industries of this country should begin training young men as toolmakers and machinists to ensure that we will have enough highly skilled men for our industries. If a census were taken in the toolrooms of the manufacturing plants, tool and die shops, it would be found that a large percentage of toolmakers are of foreign birth, due to the fact that the European method of training toolmakers in many respects is far superior to ours. This is because the apprentice is given time enough on all types of machines to become thoroughly familiar with their use. In addition, wherever possible an opportunity is given for apprentices to learn something about foundry practice. In some countries, a certain number of hours in school each week is required, and the apprentice is given training in the engineering department so as to familiarize himself with blueprints and other details. While similar systems of apprenticeship training have been adopted by some of the most progressive plants in this country their number is comparatively few. Too many plants that make a pretense of training toolmakers do not give the apprentice sufficient time on the various machine tools or on bench work to become proficient. The tendency is to let the apprentice stay on certain machines or work until he becomes a specialist instead of an all-around man.

Our modern civilization is becoming more dependent on mechanical devices. Machinery and tools are necessary in order to make the mechanical devices required. Machines, machinery and tools cannot be made without skilled labor, nor can we have mass production without it. Mechanical industries should be deeply concerned about obtaining a sufficient supply of skilled labor and we should have an apprentice system that would be national in scope to ensure the proper training of young men as toolmakers and machinists.

Wage Incentive Needed

Adequate wages should be paid during the training period, and industry must see that the skilled worker is compensated according to his ability after serving his apprenticeship. There should be a wage incentive to encourage young men to learn a skilled trade. It is logical to suppose that mechanical industries in cooperation with federal, state and local governments could work out a system of apprentice training that would be highly efficient by analyzing the various systems in use in this country and abroad. Such a system need not be costly. There is no time for delay if we are to avoid a shortage of skilled labor.

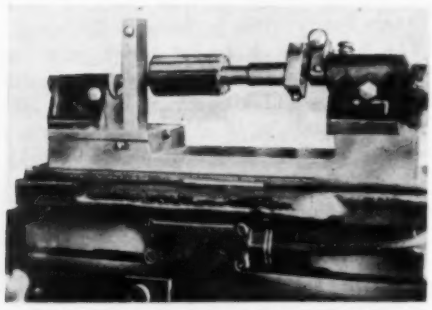
IDEAS FROM PRACTICAL MEN

Fixture for Grinding Formed Cutters

HECTOR J. CHAMBERLAND

To cut properly, the teeth of formed cutters must be ground so that their faces are radial. We had many formed cutters to grind, but as our cutter grinder was not fit for this kind of work, I made the fixture illustrated to be used on our toolroom surface-grinder. On a baseplate attached to the machine table are mounted a set of index centers and a post for carrying the diamond.

In operation, with the wheel at rest, its front side is brought radial with the centers and the diamond is adjusted to just contact with that side of the wheel.



Index centers on a surface grinder for grinding formed cutters in quantity

After mounting the cutter on a mandrel held between the centers, the dullest tooth is selected and its face is brought into contact with the wheel. The table is then moved forward slightly and the cutter is rotated an amount equal to the stock to be ground off of the tooth. With the point of the tooth against the wheel, the dog on the mandrel is tightened.

Everything is now ready to commence grinding. The machine is started, and at each pass the table is fed in slightly, grinding more and more from the face of the tooth. When the table has been fed in far enough to bring the diamond into contact with the wheel, both the front side of the wheel and the face of the tooth are radial. At this pass the diamond trues the front side of the wheel, ready for grinding the next tooth. The table is again moved forward so that the wheel will clear the cutter when it is indexed for the next tooth to be brought into grinding position. Grinding proceeds as before, the table being fed in at each pass until the diamond again comes into contact with the wheel. It will thus be seen that the wheel is trued at the finish of each tooth and is automatically kept radial regardless of its wear.

Cam-Milling Attachment For the Bench Lathe

EMIL WITTMANN

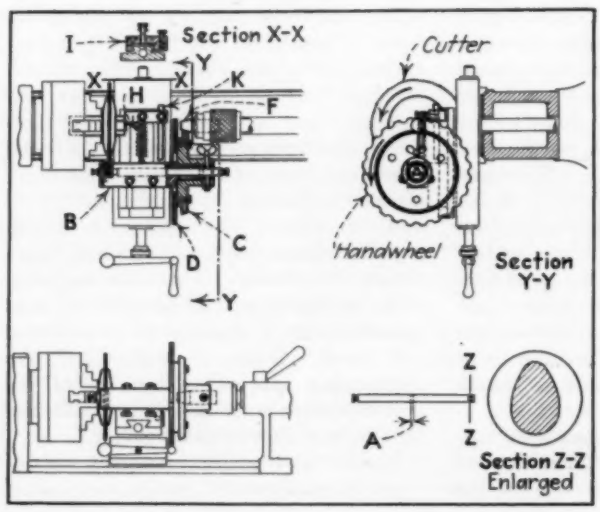
Having to mill a cam near one end of each of a large quantity of pins, we made the attachment illustrated and mounted it on the sliding member of the compound rest of a bench lathe. We found it more convenient to mill the cams near the ends of longer pins, as at *A*, and to part the pins in the center, making two pins from each of the required length. The cam is shown enlarged at the right.

The attachment consists of the holder *B* for the pins; the master cam *C;* the serrated disk *D* for revolving the master cam; the former pin *F*, held in a chuck in the tailstock spindle; the spring *H;* the sliding member *I;* and the stop bar *K*. The feed screw of the compound rest was removed, so that the sliding member was free to move in and out. At the right-hand end of the holder is a hub on which the master cam is a running fit. The serrated disk is attached to the master cam and serves as a handwheel for revolving it. The sliding member *I*, to which one end of the spring *H* and the stop bar *K* are attached is connected to the cross-feed screw of the lathe by a nut.

In operation, a pin is put into the holder against the stop screw at the left and is clamped by the thumbscrew at the right against the ends of two other screws that are so adjusted as to center the pin. In feeding the work to the cutter by means of the cross-feed screw, sliding member *I* travels toward the back of the lathe, increasing the tension of the spring and pulling the rear end of the sliding member of the compound rest against the inner end of the stop bar *K*. When the master cam contacts with the former pin *F*, the movement of the sliding member of the compound rest is stopped.

Continued revolution of the cross-feed screw pushes the sliding member *I* farther to the rear, increasing the tension of the spring, bringing the stop bar out of contact with the sliding member of the compound rest and permitting the spring to keep the master cam tightly in against the former pin. The depth of cut is adjusted by moving the former pin to the right or left, its taper against the angular face of the master cam acting as an adjustable stop. Everything being set, the master cam is revolved by turning the serrated disk with the fingers. Since the work revolves with the master cam and the sliding member of the compound rest reciprocates in unison with the contour of the master cam, the cam is milled on one end of the pin. The pin is then turned end for end for milling the other cam.

In drawing the work away from the cutter by means of the cross-feed screw, the sliding member *I* is moved toward the front of the lathe, lessening the tension of the spring. When the inner



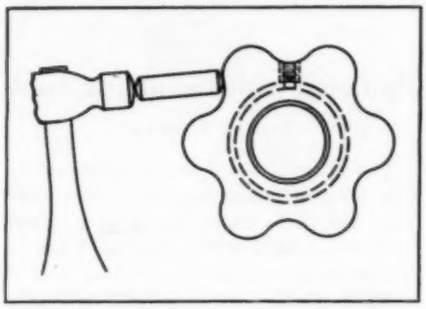
This attachment for the bench lathe allows milling a small cam on the end of a pin. The work revolves with the master cam, which controls reciprocation of the sliding member of the compound rest

end of the stop bar *K* contacts with the rear end of the sliding member of the compound rest, it pushes it toward the front of the lathe, clearing the work from the cutter.

Quick-Releasing Devices *Discussion*

B. E. R. RENAUD

In reference to the article by H. P. Camp under the title given above (*AM* —Vol. 77, page 444), the devices in Figs. 1 and 2 having lugs that rotate with the work would not be accepted in any shop that has the least amount of consideration for the safety of its operators. The device in Fig. 3 only would be safe to use in the production department. Even then, the handwheel would



A corrugated knob is suggested as being safer than a two-lug adapter

be better if it had a solid web in place of spokes.

Time and money have been spent in bending the tails, rounding the corners and burying the setscrews of lathe dogs in order to reduce the danger hazard to operators, and the first two devices shown by Mr. Camp offset all these efforts. As a suggestion, instead of the two-lug adapters, practically the same results could be obtained by using corrugated disks, or knobs, as shown in the accompanying illustration. Hitting the high parts with a hammer would have practically the same result as hitting one of the lugs on the adapters. Perhaps it would be better to use a piece of stock between the hammer and the disk.

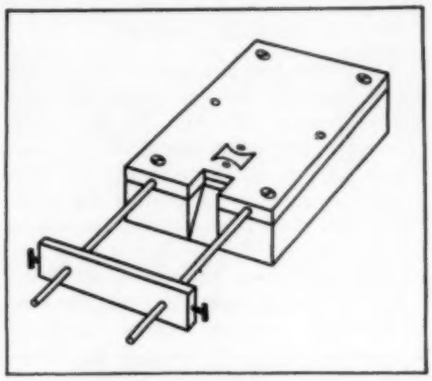
It is to be regretted that during the depression there has been a tendency, especially in small- and medium-size shops, to eliminate all safety work and even to go backward. Labor is cheap, willing to do anything for a crust of bread, mighty careful not to say a word of criticism, and safety has suffered. Conditions now exist that would not have been tolerated four years ago and it will take a lot of effort to come back to the satisfactory safety conditions that obtained before the depression.

Press Tools for Piercing and Cutting Off—*Discussion*

HARRY L. MORGAN
Smethwick, Staffs, England

Referring to the article by Charles H. Willey under the title given above (*AM* —Vol. 77, page 283), I would suggest that there is no need for the pivoted stop mentioned.

If the shearing and piercing holes are placed near the end of the die, and the die itself is cut out as indicated in the accompanying sketch, the piece severed



If the die is cut away as shown, the severed parts will drop of their own accord

from the bar will drop of its own accord. By this means production will be twice that when the pivoted stop is used.

I would add that I have used the method described with entirely satisfactory results.

Setting Screw Machines Straight

ELBRIDGE KENNEDY

The usual practice seems to be to set automatic screw machines at an angle. The reason for this is to facilitate the handling of bar stock and to utilize better the available space under the mistaken idea that more machines can be accommodated when set at an angle. Sometimes the angular setting is more economical of space, but not usually. Where the necessary width is available, the arrangement shown in the illustration is preferable from every point of view, cheapness of installation, room for material and economy of operation.

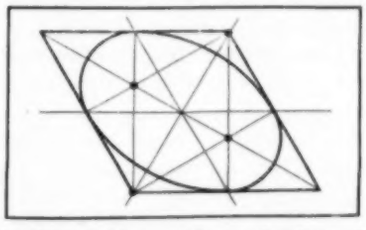
There are 64 machines in the room shown in the illustration. Material comes in the doors at the center, and the aisle is sufficiently wide to turn a 14-ft. bar. The machines are all set at right angles. The front of the machines on the aisle face in one direction and those next the windows face the other way. The receiving end of the stock carriers of the machines on the aisle are 14 ft. from the wall. The end of one of the carriers for one of the machines next to the wall may be seen at the extreme right of the illustration. This arrangement, besides giving room for one more machine than the oblique method, gives ample space between machines for feeding stock and taking away chips and finished parts.

Isometric Projection of Circles

F. TREVOR DANIEL
London, England

Excepting the arcs, all the construction lines of the isometric projection of the circle in the illustration are made with the aid of a 30/60-deg. triangle. Dividers and a rule are not necessary if the possible need for a starting dimension is neglected.

Features worthy of note in the method shown are: (a) The tangents of the circle which form the rhombus



Laying-out isometric projection of a circle with a 30- and 60-deg. triangle

Setting screw machines straight allows more units and gives ample space for feeding stock and taking away parts and chips

occur at the half-points in the rhombus; (b) the definite joining spots of the arcs are known, which is of great assistance to accurate drafting; (c) the centers for the four arcs occur on a 60-deg. rhombus, of which the longer diagonal is equal to the sides of circumscribed rhombus, while the shorter diagonal is the middle one-third of the long diagonal of circumscribed rhombus; (d) the major axis is the center two-thirds of this same long diagonal, and the minor radius is one-sixth of it, while the major radius is one-half of it; (e) the minor radius is one-third of the major radius.

Tools for Making Steel Clips

JOHN G. JERGENS

The pillar-press tools illustrated in Fig. 1 are for piercing, cutting off and first-forming the strip stock for clips for attaching wires and gasoline pipes to the chassis of automobiles.

In operation, the strip stock is fed under the stripper *A* to a point between the piercing die *B* and the forming block *C*. At the first down stroke of the ram, the end of the strip is trimmed and two holes are pierced by punches not shown. The strip is then advanced until it contacts with the face *D* of the spring-actuated stop *F*. At the next down stroke of the ram, the pierced piece is cut off and is forced down onto the forming block by the forming punch (not shown) and the end is first-formed to the shape indicated by the heavy line.

For completing the bend, the partly formed piece is transferred to the hand-operated fixture illustrated in Fig. 2. The curved part of the bend is placed over the central pin, the straight part being in contact with the square-headed pin *A*, both of which are attached to a stationary part of the fixture. The plate *B*, which is integral with the lever *C*, is rotatably mounted on the fixture and carries the bending rolls *D*. Moving the lever clockwise causes the bending rolls to bend the piece about the central pin. When the lever contacts with the stop pin *F*, the bend has been completed. At *X* may be seen one of the completed clips.

Assembly Notes on Drawings
Discussion

W. R. NEEDHAM
Stafford, England

The points touched upon in the article by William H. Kellogg under the title given above (*AM*—Vol. 77, page 343) deserve serious attention of the drafting room. When it is necessary to refer from one drawing to another for additional information concerning the job in hand, they in the shop find it most annoying and often the cause of delay. While this annoyance cannot always be obviated, it certainly can be mitigated by putting cross references on the drawings.

In the case of a principal part involving a great number of individual details, it may be quite impracticable to present the assembly and the details on one drawing. It should be arranged in so far as possible that related details be kept to the same sheet. Also, that these details, as drawn and presented in the materials list, be in natural sequence. This is, indeed, one of those little things which mean so much saving of time and temper to those whose job it is to use the drawing. Also, it adds materially in removing excuses for mistakes.

Mistakes will occur in the best regulated families and may arise even when the best regulated drawings are provided. They tend to increase, however, when arrangement and presentation are slipshod and illogical.

Where the one assembly drawing is to be accompanied by several drawings of details, it is excellent practice to cross-refer from assembly to details. A parts list, suitably interpreted by distinguishing symbols, can give both the drawing number and the part numbers of the details referred to. The parts list of the assembly, unlike the materials lists of the detail drawings, need contain name, drawing and item numbers only of the parts. Care, of course, will have to be taken that any substitution changes in the individual parts in the detail drawings receive attention in the parts list as well as in the construction work of the assembly drawing. The one, however, should suggest the other.

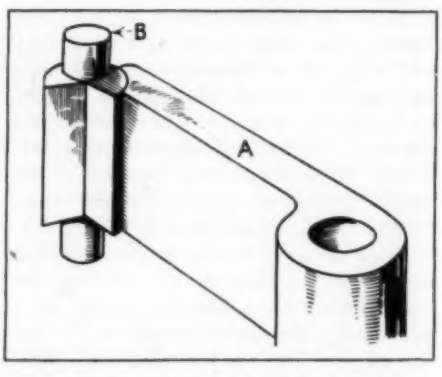
Jig Latch with Revolving Lock

CHARLES F. HENRY

The illustration shows a quick-acting lock for a swinging jig latch, that locks itself but that cannot be opened except by the operator. The leaf or latch *A* swings a pin at the right. The lock is a pin or shaft with a segment cut away as shown at *B*. The end of the swinging leaf is cut to an arc that fits the pin *B*.

In the position shown the pin locks the leaf solidly in position, its release being only possible by turning the pin until the cut-away portion permits the end of the leaf to swing out. Holding the pin *B* in the position shown by means of a spring the leaf can be swung into place, the end turning the pin to let it pass. The spring then returns the pin to the position shown, locking the leaf in position until it is released.

By making the outside of the pin eccentric with its bearings, the cam effect may be utilized to force the leaf *A* positively against a seat.



Release of latch A is allowed by cut-away portion of pin B

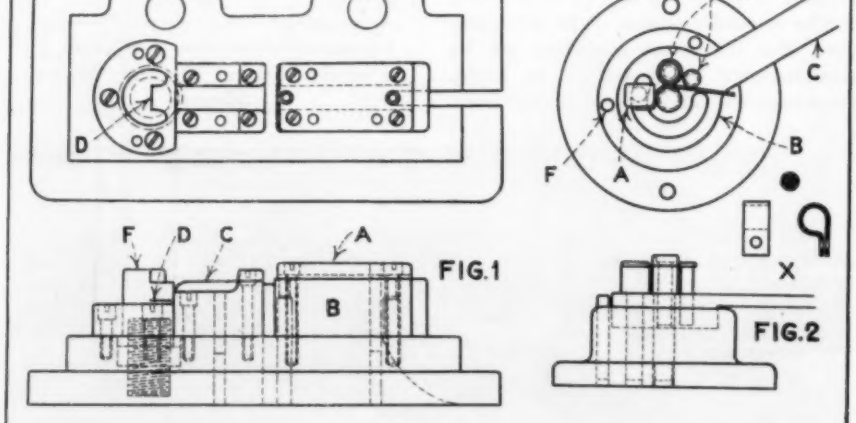


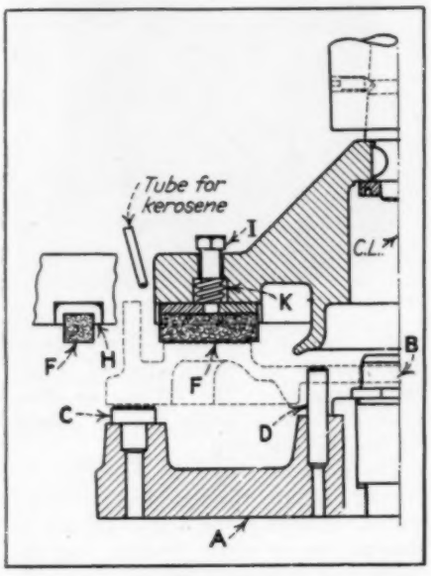
Fig. 1—Die for piercing, cutting off and first-forming the clips.
Fig. 2—The clips are completed in this hand-operated fixture

Honing Flywheel Clutch-Faces

ERNEST FOLDVARY
Budapest, Hungary

In machining flywheels for automotive engines, it seemed advisable to give the clutch faces a better finish than that left by the facing tool. Consequently, we arranged the set-up illustrated, the fixture being mounted in a drill press.

The fixture consists of the base *A* having the stud *B* for locating the wheels by the bore; the buttons *C* on which the rims rest; and the pin *D* to prevent the wheels from rotating. Since the weight of the wheels is sufficient to hold them down, no clamping is necessary. Four carborundum hones *F* are cemented in the steel holders *H*, the holders being retained in pockets in the honing tool by the screws *I*. Springs *K* maintain uniform pressure of the hones against the clutch faces, and the loose fits of the retaining screws permit them to float slightly.



Fixture used in a drillpress for honing flywheel clutch faces

Mounted in the machine spindle by its taper shank, the honing tool is held by a pointed setscrew engaging a V-groove in the shank. Kerosene is used as a lubricant, being forced through a pipe to the wheels by a small pump.

A Dog Tightener—*Discussion*

A. W. FORBES
Forbes & Myers

In the two articles under the title given above by Herbert M. Darling and L. Kasper, respectively (*AM*—Vol. 77, pages 187 and 347), each author has apparently assumed that there will be quite a number of sizes of heads on the screws of lathe dogs. But why should there be so many sizes? Why not standardize?

Our lathes, the largest of which swings 20 in., have but two sizes of heads on the toolpost screws. Our first step in standardization was to grind down the heads of the screws on the large dogs to the same size as the heads on the toolpost screws. Now, the lathe operator can use the wrench for the toolpost screw for whatever dog he wants to use. Should it be necessary for him to use a very small dog on a large lathe, he has only to borrow the wrench for the toolpost screw from one of the smaller lathes, but that is seldom necessary.

If it is desired to attach a stationary socket wrench to the lathe for tightening the dog screws, instead of using a wrench, as suggested by Mr. Darling, it can be easily done. But if the sizes of the screw heads are standardized, a socket of one size only will be needed.

SEEN AND HEARD

JOHN R. GODFREY

Cast Iron and Vibration

Controversy as to the relative merits of cast iron and welded steel construction frequently overlooks the question of vibration, or its absorption. According to experiments I have seen quoted, cast iron absorbs vibration 12 times better than steel plate and 20 times better than aluminum. The same tests indicated that the common, garden variety of gray iron was better as a base for machinery in general, than the irons with alloys that gave them added strength. These alloy irons were not as good from the anti-vibration point of view. Assuming these conclusions to be correct, and they seem reasonable, it behooves us to pick on a machine base material with an eye on the need to absorb vibration. Each material has its place and it's up to us to do the proper picking.

How Smooth Bearings?

The question as to smooth cylinder walls has its counterpart in revolving bearings as well. We know from experiments made at the Bureau of Standards and elsewhere that smooth gages wear much less rapidly than those with rougher surfaces. Smoothness seems to have more effect on wear than hardness, within limits of course. But when it comes to revolving bearings it seems reasonable that a dead smooth shaft should run better than one that is rough. And yet one railroad I know of deliberately leaves the toolmarks in its driving axle journals, claiming longer wear life due to better lubrication. On the other hand, very small high-speed grinding spindles are made with both spindle and bearing of hardened steel, ground and lapped to a dead smooth finish. The clearance is so close that machine oil will stick the bearings. The usual lubrication is to wipe the spindle (which traverses the bearing while running) with a cloth dampened in kerosene. Lubrication may be the crux in all bearings.

Knowing the Metals to Use

Not only the machine designer but the successful job shop manager should know a lot about materials. An oil refinery, for example, finds the rods in its brine pumps only last from 4 to 6 months. The job shop man is asked if there isn't some metal that will stand up better than steel on this pump. If the job shop man is posted he knows the advances made in corrosion resisting metals and suggests monel, bronze or whatever other metal he knows is better than steel for this work. The job shop man who knows most about the machine end of the business usually gets the best customers.

Chrome Plated Taps

Chromium plating of tools crops up again, this time in the shape of taps for use on Bakelite and similar material. These plastics are notoriously hard on tools and many use tungsten-carbide or diamonds for turning and boring. By chrome plating standard taps some users claim to get about five times the normal life. Then, too, they can be replated, as has been pointed out previously.

Gears That Are Too Good!

As brought out in a recent article making quiet gears is a problem that requires careful study. I recently found a case where they occasionally make them too good. The device manufactured is one in which very high speeds must be had at the end of the train of gears, and in which it is next to impossible to avoid more or less hum from the gears that run at the higher speeds. Yet once in a while, for no special reason that can be traced, a machine comes down the line that is practically silent. But instead of patting themselves on the back, they tear down the machine and put in a gear or two that gives the usual hum. They do not dare send out one so much quieter than the run-of-mine machine. If your neighbor got this machine and yours was ordinarily noisy, you would kick for a quiet machine. So they see that no extra quiet machine leaves the plant.

SHOP EQUIPMENT NEWS

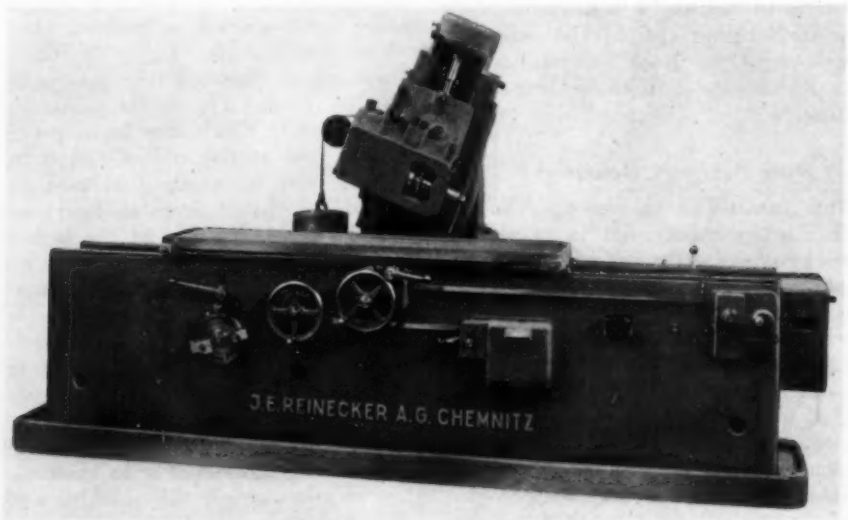
Reinecker Rack-Cutting Machine

By means of a swiveling cutterhead a helical rack can be cut by the Reinecker rack cutting machine in addition to a straight-tooth rack. This machine has been placed on the market in the United States by the George Scherr Co., 128 Lafayette St., New York, N. Y. For cutting helical teeth, either left- or right-hand, the cutterhead can be swiveled in the vertical plane to 30 deg. For the cutting of other types of teeth, the cutterhead can be swiveled in the horizontal plane. Fully automatic operation is provided, the machine indexing from tooth to tooth and using a disk type of cutter.

Two motors provide the necessary drives; first, a flanged-type motor for the cutter drive, operating through pick-off gears and a suitable gear ratio, and, second, a flanged-type motor operating the feed and return of the cutter as well as the indexing motion to the table. The table travel is automatically disengaged by an adjustable stop upon completion of the cutting operation.

Adjustable taper bearings carry the cutter spindle. An outward, removable bearing for the cutter arbor is provided. The feed of the cutterhead can be changed within wide limits by means of pick-off gears. Controls are centralized.

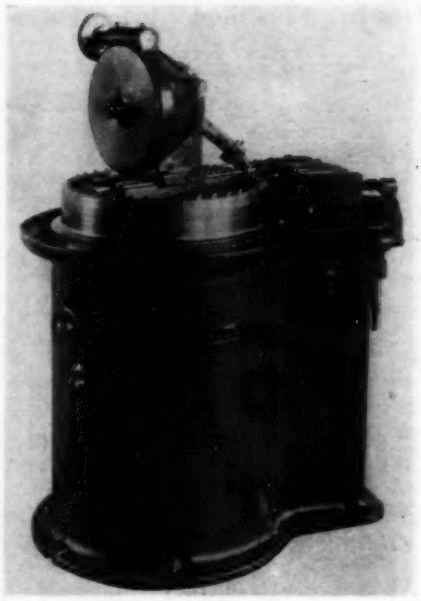
For the finer pitches, the use of gang cutters is recommended whereby several teeth can be finished at one time. For tough material or large pitches, roughing and finishing cutters are mounted alongside of each other on the cutter arbor.



Helical racks, straight-tooth racks, and racks where one s'de of the tooth forms an acute angle with the base line can be cut on this Reinecker machine

Globe Horizontal Dial Tapping Machine

An automatic horizontal dial-type tapping and screw inserting machine has been developed by the Globe Tapping Machine Co., 751 Central Ave., Bridgeport, Conn. This machine has been designed for light drilling, tapping, threading, screw inserting, burring and other operations, the operator only placing the parts into the dial ring, all other functions being automatic including the ejection. An automatic lubrication pump supplies all machine bearings. Drive of the machine itself is provided by a 1,200 r.p.m. motor mounted on an adjustable tilting plate in the base. Every operation is visible and easily adjusted. Units can be placed in the vertical or other angles. Uniform parts can be hopper fed to the dial ring.

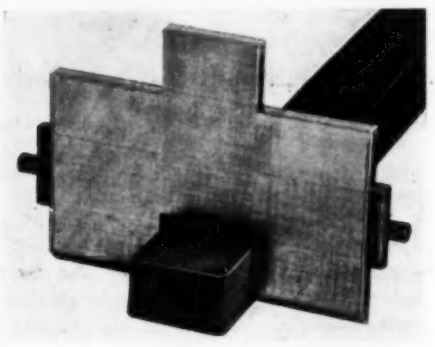


The machine shown is tooled up for tapping, hopper feeding and inserting screws, upsetting the screw thread to prevent loss of screw, backing out the screw and automatically ejecting electrical contact blades at a rate of 80 pieces per min. Only completed parts with the screw in them are ejected.

Stockton Profile Gage

A laminated gage for checking temporary or permanent templets of any contour or angle has been developed by the Stockton Profile Gage Co., 18 New Derby St., Salem, Mass. The gage is made of metal laminations that adapt themselves to any shape. After the desired profile is obtained, it may be held by tightening the tension nut for this purpose. The instrument may be placed flat on a drawing board or the work for the purpose of marking cutouts.

The standard gage is made of lamina-



tions of 0.032 in. duralumin. Certain of the standard gages have laminations square on both ends, while others have laminations beveled at 45 deg. on one end. Precision gages have 0.020-in. laminations, and may be had square or beveled. Wonham, Inc., 44 Whitehall St., New York, N. Y., is the general distributor for the Stockton gage.

"Bestolife" Metallic-Lead-Base Lubricant

The Armite Laboratories, 1450 East 51st St., Los Angeles, Calif., has developed a lubricant in which metallic lead is the protective element. The lead is broken down into finely divided particles, so that it is virtually a soluble or liquid lead within a lubricant vehicle. The product, known as "Bestolife," forms a thin protective film of lead on all contacting surfaces, and is claimed to improve the anti-frictional characteristics thereof. The lubricant is said to withstand temperatures up to 420 deg. F. The principal application of the product in the machinery field is for use as a gear and roller bearing lubricant and as a belt dressing.

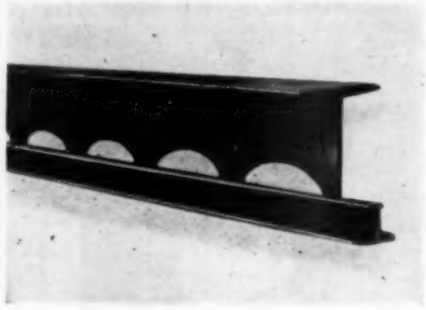
USL Protected Arc Welder

A welding range of 50 to 550 amp. and a rating of 40 volts are found in the "Protected" arc welder developed by the USL Battery Corp., Niagara Falls, N. Y. All kinds of bare or coated electrodes can be handled. Armatures on the motor, generator and exciter are all mounted on a single shaft to eliminate mis-alignment between the motor and generator. Heavy-duty ball bearings are employed on the shaft to maintain a uniform gap between the fields and armatures.

The USL 300 amp. size shown, besides having the ratings given above, has overall dimensions as follows: 52 in. in length, 26 in. in height, and 24 in. in width. The weight is 1400 lb. Complete inclosure of mechanism prevents damage from the weather or from falling objects.

"Cleveland Tramrail" 8-In. Beam

The Cleveland Tramrail Division, Cleveland Crane & Engineering Co., Wickliffe, Ohio, has placed on the market the Series 2400 arch beam rail designed for loads up to two tons. The rail is for use where it is not practical or economical to install superstructure between existing roof trusses for the support of the standard Tramrail rail. Where it is possible to attach supporting fittings to existing trusses or columns no superstructure is required on arch beam spans of twenty feet or less. The ball

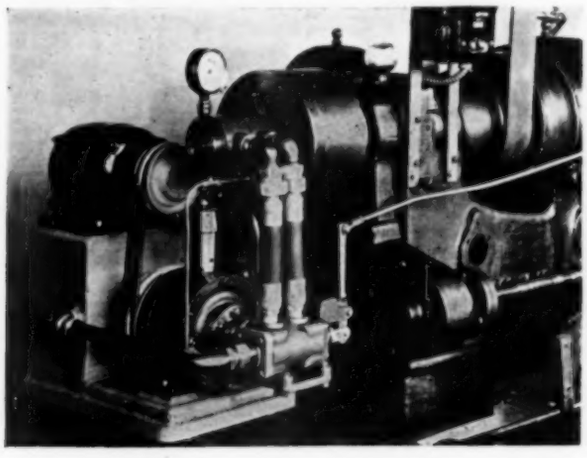


and socket method of flexible suspension has been incorporated in the design of the ceiling fittings.

The arch beam rail is built of a half section of a structural steel beam, from the web of which semi-circular sections have been punched at close intervals to form a series of arches. This structural section forms a supporting member for the standard high-carbon steel Tramrail rail, which is welded to the beam.

Tomkins-Johnson Electric-Hydraulic Chuck-Operating Unit

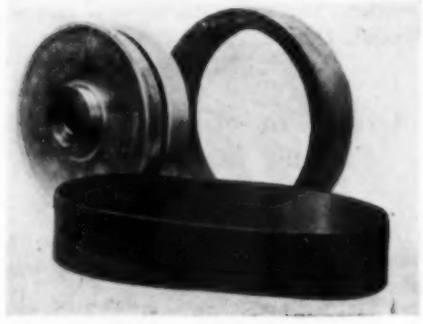
The Tomkins-Johnson Co., Jackson, Mich., has developed on electric-hydraulic chuck-operating unit which is readily mounted on a machine and which is capable of working pressures up to 250 lb. per sq.in. Oil from the tank is pumped to the pressure required and then sent through a valve and distributor to the cylinder. To release the chuck a valve is caused to reverse the flow of oil into the opposite end of the cylinder, the exhaust oil returning to the tank. Although running continuously, the motor is under load only for short intervals when the pressure is being returned to the desired level. The oil is not bypassed, thereby avoiding heating.



Compact in construction, the Tomkins-Johnson Electric-Hydraulic Chuck-Operating Unit is easily mounted on the machine and provides chucking power adjustable to suit the work

"Cleveland" Turkish-Emery Polishing Sleeves

Endless abrasive polishing sleeves coated with Turkish emery were recently developed for use with its expanding polishing wheels by the Cleve-



land Container Co., Abrasive Division, 10530 Berea Road, Cleveland, Ohio. The sleeves are made by the same process as used in fabricating the company's aluminum - oxide "Nolap" abrasive sleeves. The Turkish emery sleeves make possible a high luster on aluminum, steel and other metals, whereas aluminum oxide sleeves leave minute scratches because of the inherent hardness of aluminum oxide. The Turkish emery sleeves can be used dry or with grease, oil or emery cake.

Porter-Cable Type T-3 Sander

A sander with a 3x24 in. belt but with no dust-collecting system has been developed by the Porter-Cable Machine Co., Syracuse, N. Y. Known as the Type T-3, this sander can be used for polishing metal surfaces, either flat or curved. One feature of the sander is its good balance, not only from right to

left but from front to rear, accomplished by placing the motor in a horizontal position. The sander has a ½ hp. motor. Weight, 15 lb.

Gray Turret-Head Metal Cutter with 36-In. Throat

A larger size has been added to its line of turret-head metal cutters or nibblers by The Gray Machine Co., Box 596, Philadelphia, Pa. This machine has a 36-in. throat with capacity for cutting $\frac{3}{16}$-in. mild steel at 30 ft. per min., cutting anywhere in sheets 6 ft. wide and of any length. The turret turns for cutting various shapes in large sheets that will not turn through the throat. The improved turret-locking mechanism permits the turret to be locked in ten fixed positions at the front of the machine. This locking mechanism remains in a fixed position at the front, whereas in earlier machines it rotated with the turret, making it difficult to reach.

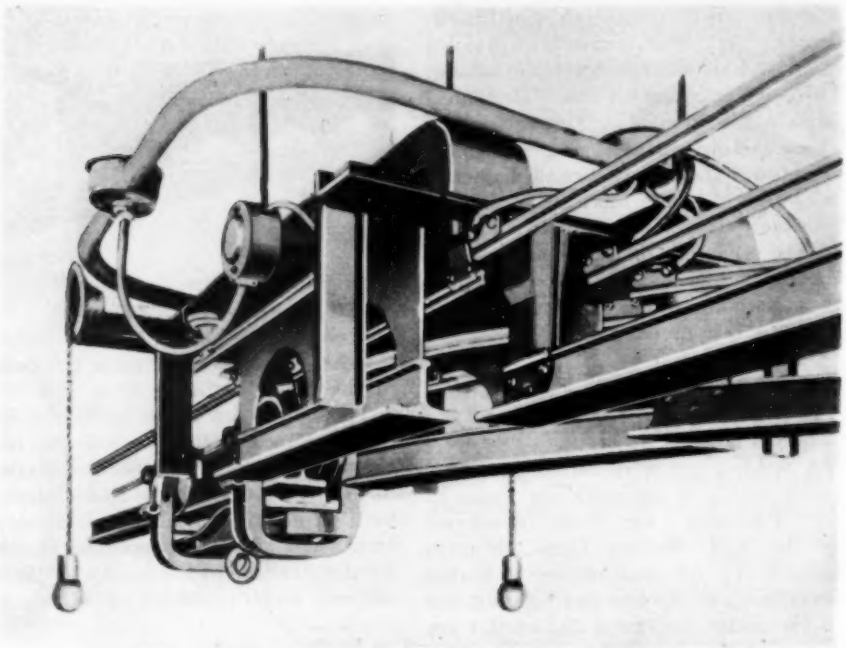
A two-speed telescoping flywheel is another feature. When heavy stock is to be cut at maximum speed, the flywheel is in one position for operating the cutter at 550 r.p.m. When light stock is to be cut, the flywheel is slid rearwardly on the lineshaft, uncovering a smaller belt pulley in line with the motor that operates the cutter and drive shaft at 1,200 r.p.m.

Mild steel up to 3/16 in. thick by 6 ft. wide and by any length can be cut on the Gray Turret-Head Metal Cutter or Nibbler. A two-speed telescoping flywheel makes it possible to obtain maximum cutting efficiency on both light and heavy stock

"Cleveland Tramrail" Type "D" Switch

The Cleveland Tramrail Division, Cleveland Crane & Engineering Co., Wickliffe, Ohio, has developed the Type "D" switch, suitable for all types of the company's hand-propelled carriers and for certain types of electrically operated carriers, but more compact and permitting a closer switch grouping and rail spacing than is possible with the company's standard sliding-type switch.

The switch consists of two main parts, a rigid outer frame and a sliding inner member fitted and guided to maintain alignment of the switch and incoming

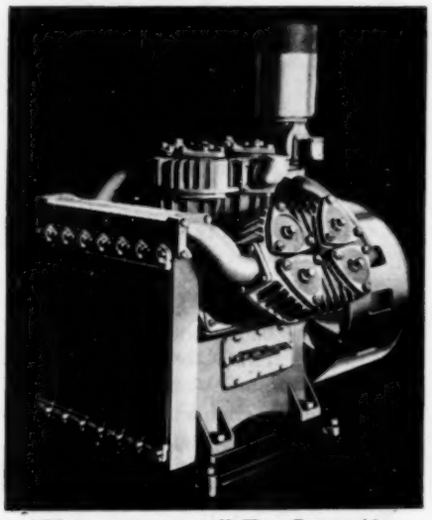


A closer switch grouping and rail spacing are afforded by the "Cleveland Tramrail" Type D Switch

rails. Safety guides welded to the switch frame prevent the carrier from being run off the rail. The switch can be electrified at any time. The Type "D" switch fills the requirements for a switch of a type intermediate between the standard sliding-type switch and the tongue-type switch. The Type "E" switch is similar to the Type "D", but is suitable for use with hand-propelled carriers only and for loads not to exceed one ton. It cannot be electrified.

"Motorcompressor" Air-Cooled Air Compressor

The Ingersoll-Rand Co., 11 Broadway, New York, N. Y., has developed an air compressor that requires no cooling water, known as the "Motorcompressor." This compressor has a built-in electric motor, the rotor being carried on the



"Motorcompressor" Two-Stage Air-Cooled Air Compressor with built-in motor

compressor shaft and the frame being bolted to the compressor crankcase.

The Motorcompressor is a 2-cylinder, 2-stage machine. Cylinders and intercooler are air-cooled. Units are built in sizes from 20 to 50 hp. with piston displacements from 113 to 310 cu.ft. per min. and for discharge pressures up to 125 lb. gage. The overall efficiency is equal to or better than that of conventional water-cooled compressors of the same rating.

"Cleveland Tramrail" Type CHS Crane

The Cleveland Tramrail Division, Cleveland Crane & Engineering Co., Wickliffe, Ohio, has developed a line of cranes and transfer bridges of light weight, suitable for loads up to one ton where the bridge span is not over 16 ft. These units are suitable for hand-propelled carriers, either with or without chain- or motor-operated hoists, and operate on runways of Cleveland Tramrail standard rail or arch beam.

These cranes and transfer bridges are constructed of a section of the company's 8-in. arch beam rail used as the crane bridge, and its standard one-ton hand-propelled carriers as the end trucks. Electrical fittings can be added to change the system from one using chain hoists to one using motor-operated hoists.

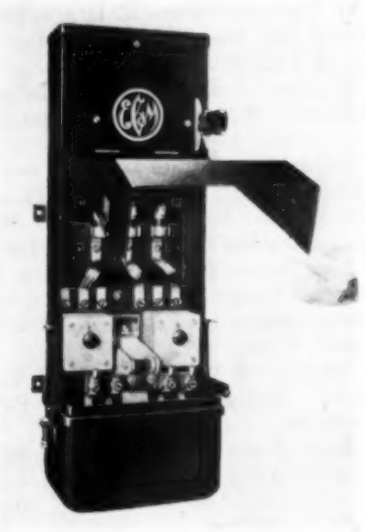
Square D Type B20 Pushbutton Station

Extra large pushbuttons, 1 in. in diameter, are used in the Class 9001, Type B20 pushbutton station now offered by the Square D Co., Industrial Controller Division, Milwaukee, Wis. The buttons and stems are molded of bakelite and are supported by strong compression springs with an additional follow-up spring at the contacts. Contacts are silver-to-silver, double break. The mechanism is mounted on a porcelain base and is removable as a unit.

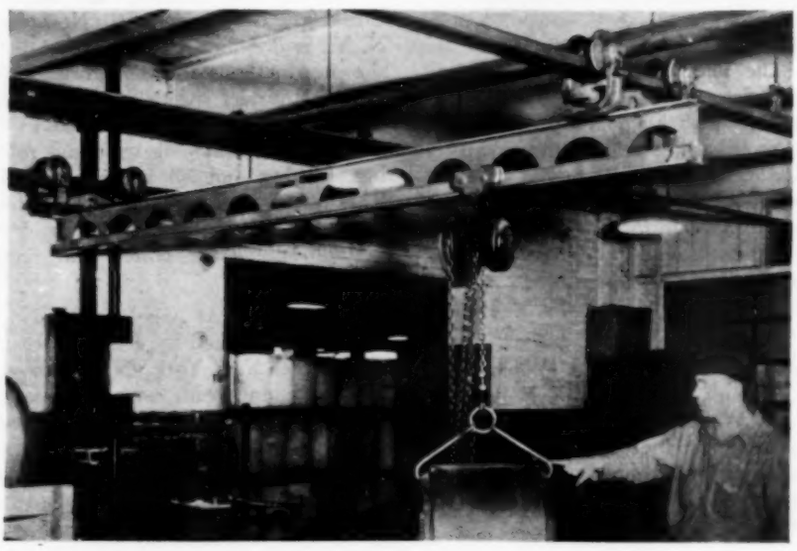
Mounting dimensions are 2½ in. wide by 4¼ in. high by 2⅞ in. deep. The station is also built with a dust-tight and water-tight inclosure.

E C & M No. 1 Type ZOS Across-the-Line Magnetic Starter

For motors up to 15 hp., 220 volts, and 30 hp., 440-550 volts, the Electric Controller & Mfg. Co., E. 79th St. & Woodland Ave., Cleveland, Ohio, has developed the No. 1 Type ZOS oil-immersed, across-the-line, combination magnetic starter, containing an unfused or fusible safety switch, a magnetic starter with overload relays and heavy-duty test jacks. All internal wiring is

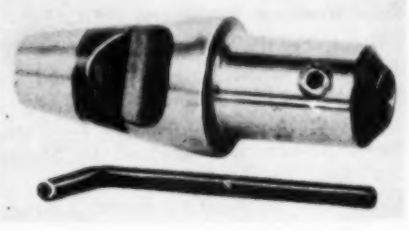


complete. Although designed for severe service, these starters are small and narrow, having the safety switch front-operated and a cover that swings vertically. Safety switches have wiping wedge, double-break contacts.



B & S Cutter Adapters for Straight Shank End Mills

For use with spindles and adapters with cam lock and having a No. 30 milling machine standard taper hole, the Brown & Sharpe Mfg. Co., Providence, R. I., is now offering a line of cutter



adapters for straight shank end mills. A feature of the spindles and adapters with the cam lock is the locking cam which draws the cutter, arbor or adapter securely to a seat and furnishes a positive drive. The surface of the cam engages the flat surface of the groove in the shank of the cutter. The shank is held in contact with the walls of the taper hole by a spring to permit the slot to square itself with the cam in drawing the shank into the hole, thus insuring a positive lock.

• PATENTS •

AUGUST 15, 1933

Metal-Working Machinery

Milling Machine. Arthur F. Bennett, West Barrington, R. I., assigned to Brown and Sharpe Manufacturing Co. Patent 1,922,073.

Machine Tool. Albert M. Johnson, Rockford, Ill., assigned to Barnes Drill Co. Patent 1,922,246.

Tailstock for Lathes, Grinders, and the Like. Adolph Storm and Thor Thorsen, Minneapolis, Minn., assigned to Storm Manufacturing Co. Patent 1,922,404.

Lead Screw Drive for Grinding Machines. Stanley W. Bath, Shrewsbury, Mass., assigned to John Bath & Co. Patent 1,922,520.

Machine Tool. Johann Emil Thiermann, Stuttgart, Germany. Patent 1,922,751.

Method of and Machine for Producing Gears. Allan H. Candee, Rochester, N. Y., assigned to Gleason Works. Patent 1,922,756.

Tools and Attachments

Head for Forming Rolled and Extruded Metal Articles. Theodore M. Hiester, Dayton, Ohio, assigned to United Aircraft Products, Inc. Patent 1,922,087.

Mechanism for Extruding and Rolling Metal. Theodore M. Hiester, Dayton, Ohio, assigned to United Aircraft Products, Inc. Patent 1,922,088.

Processes

Gaging of Screw Threads. James Hartness, Springfield, Vt. Patent 1,922,849.

AUGUST 22, 1933

Metal-Working Machinery

Rivet Feeding Machine. James W. Hughes, Detroit, Mich., assigned to Budd Wheel Co. Patent 1,923,377.

Lapping Machine. Clyde E. Parkhurst, Moline, Ill., assigned to Moline Tool Co. Patent 1,923,390.

Machine for Cutting Screw Threads. Reuben S. Crosby and Frank E. Newton, Hartford, Conn., assigned to The Asa S. Cook Co. Patent 1,923,423.

Lathe. John E. Lovely, Springfield, Vt., assigned to Jones & Lamson Machine Co. Patent 1,923,493.

Grinding Machine. John A. Smith, Cincinnati, Ohio, assigned to The United States Electrical Tool Co. Patent 1,923,760.

Grinding Machine. Clarence C. Stevens, Forestville, Conn., assigned to The New Departure Manufacturing Co. Patent 1,923,762.

Gear Tooth Rounder. Hubert D. Tanner, West Hartford, Conn., assigned to Pratt & Whitney Co. Patent 1,923,763.

Feed Mechanism for Machine Tools. Carroll Knowles, West Hartford, Conn., assigned to Pratt & Whitney Co. Patent 1,923,786.

Grinding Machine. Don F. Jones, Beloit, Wis., assigned to Gardner Machine Co. Patent 1,923,931.

Milling Machine Structure. Edward J. Kearney, Wauwatosa, Wis., assigned to Kearney & Trecker Corp. Patent 1,923,935.

Tools and Attachments

Self Opening Die Head. Albert F. Breitenstein, New Haven, Conn., assigned to The Geometric Tool Co. Patent 1,923,786.

Circular Chaser Die Head. William J. Hogg, Cleveland, Ohio, assigned to The National Acme Co. Patent 1,923,265.

Worktable for Drill Presses. Wilson P. Hunt and Rudolph E. Herrstrum, Moline, Ill., assigned to Moline Tool Co. Patent 1,923,440.

• TRADE PUBLICATIONS •

BEARING METAL DATA. Under this title the Federal-Mogul Corp., Detroit, Mich., presents the result of a survey of the bronzes by a group of technical men representing bearing manufacturers and a research carried on at the Battelle Memorial Institute. The booklet clears up certain inconsistencies in present standards and shows that too narrow specifications increase the cost without a gain in quality. Six well-known bearing bronzes were studied.

GAGES. The Stockton Profile Gauge Co., Salem, Mass., for which Wonham, Inc., 44 Whitehall St., New York, N. Y., is general distributor, has issued a circular on its profile gage showing how a profile can be obtained as well as the reverse.

HYDRAULICALLY OPERATED DEVICES. The Logansport Machine Co., Logansport, Ind., has issued Catalog AH-30, as of July 1, 1933, on hydraulically operated devices such as chucks, cylinders, valves and power devices. These devices are for operation and control of machine tools and other equipment.

LATHES. Bulletin No. 101-A, issued by the Technical Service Dept., South Bend Lathe Works, South Bend, Ind., describes underneath belt motor-driven lathes of the back-geared, screw-cutting type in sizes from 9 to 18 in. swing and bed lengths from 2½ to 14 ft. There is also shown a complete range of countershaft driven lathes. Attachments, chucks and tools fitting both types of lathes are listed.

PRESSES. Zeh & Hahnemann Co., 182 Vanderpool St., Newark, N. J., has published a catalog illustrating, describing and listing specifications for its patent percussion power presses, straight-side, single-crank presses, reclinable power presses and power punching presses.

PRICES VS. PRODUCTION. No. 2 in a series of booklet-editorials by Allen W. Rucker in collaboration with N. W. Pickering, president, Farrel-Birmingham Co., Inc., Ansonia, Conn., is devoted to "Prices versus Production." It is stated in the booklet that the decline in physical production has been much greater than the decline in prices. It is claimed that the true point of attack now is restoration of business volume of physical output in contrast with artificial efforts to raise or maintain prices. Price equalization is considered as most desirable. No. 3 of the series, entitled "A Key to Industrial Recovery," shows that the installation of improved machinery is in keeping with the spirit of the recovery program and benefits both employer and labor by permitting higher earnings to both.

NICKEL-CLAD STEELS. H. Boker & Co., Inc., 101 Duane St., New York, N. Y., is distributing a 12-page bulletin showing methods for the fabrication of nickel-clad steel sheets, strips and wire. The booklet includes hot and cold work, drawing and stamping, riveting, soldering, brazing and all kinds of welding. The various kinds of welds are shown, as well as other kinds of joints and suggested designs for bolted and flanged heads.

VALVES. A 264 page Catalog No. 23 has been published by Jenkins Bros., 80 White St., New York, N. Y., covering 400 valves in a wide range of types and patterns. All features of the design and construction are fully described. Services, pressures, temperatures and fluids for which the valves are recommended are stated.